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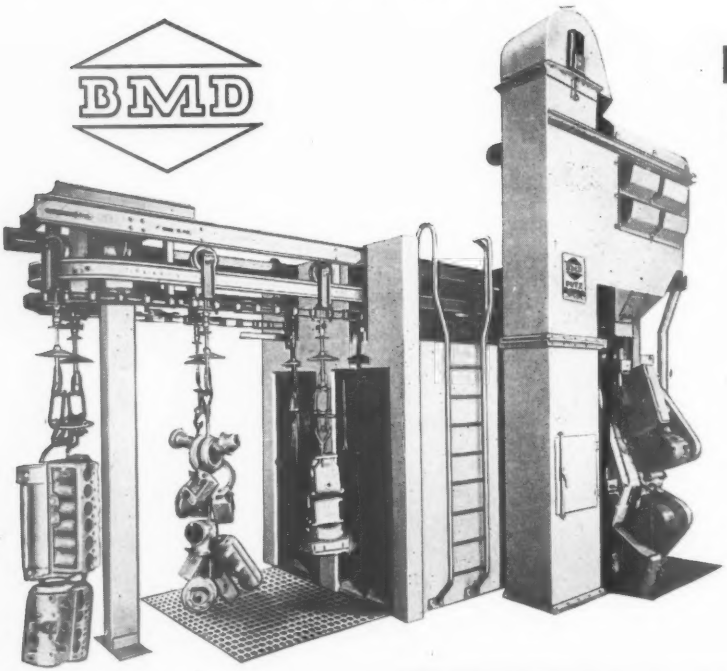

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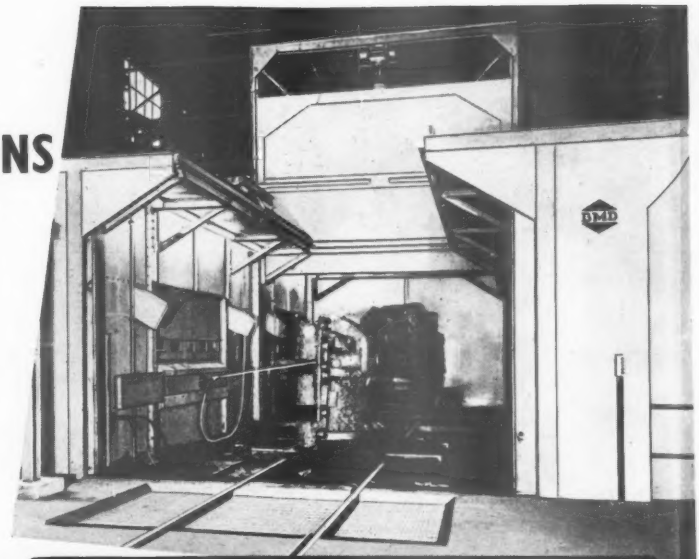

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Which to Delegate?

Large foundries employ sales managers, public-relations personnel, safety and purchasing officers, cost accountants, and production engineers; yet in the smallest concerns, one man, often the owner himself, has the responsibility for all these functions. It is of interest to speculate which of the executives mentioned would be the first to be added to the staff when the owner/manager type of firm expands. Probably the initial increase would be the acquisition of a salesman, as the whole future of any concern depends on a substantial order book. Then, because every foundry owner knows quite well that it is not difficult to fill up a shop with orders at an uneconomic price, it would seem that the second step might be to employ a knowledgeable cost clerk. With these two duties delegated, it is profitable, when considering further expansion of the concern, to imagine what is the next most time-consuming job a manager attends to personally. Probably, it is the interviewing of travellers, who always happen to arrive at a time when he is thrashing out with his foreman some difficulty over production priorities. The foundry owner knows quite well that his customers' major complaint is invariably about failure to fulfil delivery promises—this is the more important because it adversely affects goodwill, and often loses a good customer. Thus, it would appear that dealing with delivery schedules should be one of the last jobs to be delegated. The more successful the new sales manager, the more difficult becomes the problem of servicing customers. Thus, the owner of the small foundry must continue to be his own production engineer—using the expression in its broad sense, meaning that he takes decisions as to which orders take priority, and which man, or section, shall undertake the work. As a personnel officer's job is to engage labour and treat with the trade unions and various employment bureaux, this normally, in a small concern, can be regarded as not making too great a demand on the owner's time.

The remaining job we have listed—that of the safety officer—is not to be dismissed lightly. It entails much more than going round the shops, making a general survey, issuing orders, and then sitting back with the feeling that that particular assignment has been covered once and for all. Instead, accident prevention must be a continuous campaign, carried out with an enthusiasm which will spread down through the foremen to the youngest apprentice. One steelfoundry owner, who had spent large sums of money to minimize silicosis risk, was rightly disgusted and annoyed to find fettlers using the air hose as a clothes brush, instead of changing into "walking out" clothes—for which purpose buildings had been erected at considerable expense. Much "safety" work involves the eradication of bad habits and these obviously require insistent personal propaganda. If the owner of a small foundry can create

Which to Delegate?

enthusiasm, his safety problems will be lightened and the number of insurance claims reduced. It should be borne in mind that accident compensation, when it is awarded, bears no relation to the size of the foundry but only to the effect of the mishap on the earning capacity of the claimant.

It is just as well for the owners of these small foundries to ponder over this question as to why the largest shops employ specialists and to see that either they themselves, or their limited staff, do in fact carry out these same functions.

Film Review

"Milling and Smelting the Sudbury Nickel Ores." Second film in a series of sound and colour films produced by the International Nickel Company of Canada Limited, and presented by the Mond Nickel Company, Limited, Thames House, Millbank, London, S.W.1.

Filmed at Copper Cliff and other INCO plants in the Sudbury area of Ontario, Canada, this 54-minute film shows the intricate processes by which nickel—and 13 other elements— are extracted from the Sudbury ores. It covers all the stages in milling and smelting operations, commencing where the first film in the series, "Mining for Nickel" (JOURNAL, August 9, 1956; 128) ended, and follows the reduction processes from the time the ore is magnetically separated into "massive" and "disseminated" types, until the metals are either shipped to industry or despatched to refineries.

An hour is a long time for UK audiences to sit through a film showing technical processes, accompanied by an American commentator, but for the sake of completeness it is difficult to see what could have been omitted. As it is, clever "animation" is relied upon to preserve continuity between the processing sequences filmed "on location." The difficulty of catering for the diverse range of viewers for whom the film is intended is shown by the fact that it is apparently thought necessary to define a blast-furnace in the script, yet it is not considered worth while to define a "matte." Some of the best shots, in the reviewer's opinion, are those showing froth-separation processing. In fact, the whole makes a wonderful story of metallurgical development for students and others whose interests lie that way.

London Metal Exchange is 75

The world's leading free market in copper, tin, lead, and zinc—the London Metal Exchange—celebrates its 75th anniversary this year. Although the exchange was registered in 1881 and the market moved into the present building the following year, it was, 75 years ago, already something of an accepted institution in the City. Merchants had for some time been meeting informally in the Royal Exchange and elsewhere and, like Lloyd's, the exchange had its real beginnings in the coffee houses for which London was famous at the beginning of the 18th century.

During the last war, the London Metal Exchange was closed completely, and it was not until 1949 that dealings in tin were resumed. Dealings in copper, the last metal to be freed, restarted as recently as 1953. There are at present 74 member firms, but only 26 who have deposited the required guarantees are allowed to undertake actual dealings in the ring. At the short morning and afternoon sessions each metal is dealt with in turn, and at the end of the session a fixing committee fixes official quotations on the basis of the last business done. For late orders, traders operate in the "Kerb Market"—an unofficial market which lasts for 15 minutes after each session.

Growth of fixed prices, direct producer-to-consumer contracts, and the changeover of the US to an importer, has tended to reduce the tonnage volume of business going through London, but the exchange still remains the best, and probably the only, guide to world movements in demand and supply.

Near Record Export of IC Engines

Highest total for four years of direct exports of internal combustion engines (including engines for marine purposes) is reported for 1956 by the British Internal Combustion Engine Manufacturers' Association. The exports last year totalled in value £34,690,000, an increase over 1955 of 17.1 per cent. The 1952 figure reached a record of £35,350,000.

The figures cover all petrol and diesel engines used for stationary, industrial, marine, and rail traction purposes, but not those used in road vehicles, tractors, or aircraft. Notable increases were made in 14 territories including Australia, India, Norway, Iraq and Iran, and some dollar markets. In New Zealand, Syria, Saudi Arabia, Colombia, and Argentina, exports fell. Direct exports in 1956 of engines used for marine purposes were valued at the record high total of £9,170,000, a 27.7 per cent. increase over 1955.

Three Generations

It is no new thing for John Harper & Company, Limited, Willenhall, to have three generations of one family working for them. When S. Bradley, junior, recently entered into his apprenticeship at Harper's, he completed another such trio, shown in the photograph. At the right is Mr. J. Bradley, foreman cupola attendant (25 years' service); his son, Mr. S. Bradley, cupola attendant (20 years'), is on the left, and the latest recruit stands between father and grandfather.

Fatigue of Cast Iron*

By H. Morrogh

As an essential preliminary to his examination of the whole field of fatigue in relation to cast irons, the Author briefly describes the types of iron available to industry. Next, in the section printed in this issue of the JOURNAL, *test-pieces for fatigue testing, their relation to section size and other test details are dealt with, in addition to methods of expressing and interpreting results. In the section allocated to the consideration of results secured to date, such subjects as crankshaft applications, endurance limit, notch sensitivity, effects of under- and over-stressing are included.*

General Mechanical Properties

A. Flake-graphite Grey Cast Irons

Flake-graphite cast irons are all brittle; they do not behave elastically over any portion of the stress range; their mechanical properties vary with cast section size, but they have good wearing and damping properties. Angus[1] and Collaud[2, 3], and many others, have dealt with the variation of mechanical properties of grey cast iron with section. Collaud[2, 3] has discussed the stress/strain curve for cast iron in detail and has attempted its mathematical formulation.

B. Malleable Cast Irons

Malleable cast irons are usually ductile materials showing an elastic portion in the stress/strain curve. The normal varieties of this material have tensile strengths of 18 to 26 tons per sq. in., but pearlitic blackheart malleable iron is usually considerably stronger.

C. Nodular Cast Irons

In the as-cast condition, nodular-graphite cast irons have tensile strengths between about 30 and 50 tons per sq. in., with 0.05 per cent. proof-stress values of between 20 and 38 tons per sq. in., and hardnesses of 230-300 BHN. In the heat-treated condition they may be completely ductile in the impact test, having tensile strengths between about 23 and 28 tons per sq. in. with 0.05 per cent. proof-stress values of between 15 and 19 tons per sq. in. and hardnesses of 130 to 170 BHN. Bailey[4] has recently attempted a comprehensive appraisal of the mechanical properties of these irons. Nodular cast irons represent a new range of materials and special compositions can give mechanical properties outside the ranges indicated.

Most of the data available on the fatigue of cast iron refer to normal flake-graphite material. During the last four or five years, however, a limited amount of fatigue data has accumulated on the nodular cast irons, but relatively little information is available on fatigue of malleable cast irons.

Test-pieces and Test-bars for Fatigue Testing

Fatigue testing generally requires the provision of large numbers of test-pieces of uniform properties and structure. For exacting standards, this is difficult to achieve with cast materials, partly because the structure and properties of grey and malleable cast iron vary appreciably from edge to centre of the section. Thus, small test-pieces cut from large sections probably give little indication of the true properties of large sections. Nevertheless, most fatigue properties of cast iron have been determined on test pieces of 0.035-in. dia. or less; fatigue limits have been expressed in fractions of a ton per sq. in. and conclusions based on variations of less than 1 ton per sq. in. have often been drawn.

The inherent heterogeneity of cast iron and the variations which occur during the pouring of the metal add to the difficulty of providing batches of test-bars of uniform properties for fatigue purposes. Test-pieces from the widest variety of castings have on occasion been used. Moore, Lyon and Inglis[5, 6, 7], for instance, prepared 0.35-in. dia. test-pieces from cylinders having walls ½ to 3¼-in. thick, while Collins and Smith[8, 9] prepared test-pieces from blocks 3 by 3 by 56 in., sectioned longitudinally into nine bars each 1-in. square, from 1.2 in. dia. bars 20-in. long, and from a large vertically-cast plate 1¼-in. thick. Certainly, with the casting of large flat plates it would be difficult to ensure the soundness of the castings.

No systematic tests have been carried out on the reproducibility of fatigue-test results on cast iron, but at the British Cast Iron Research Association an investigation of normal tensile-strength variations on batches of over a hundred test-bars indicated the range of variation to be expected. On one batch of test-bars 1.2-in. dia. and 21-in. long, having an average of 18.3 tons per sq. in. tensile strength, the difference between the highest and the lowest in 14 tests was 2.3 tons per sq. in., representing a variation of 12.7 per cent. on the average. In addition, the tensile strength at the bottom half of the bar, with few exceptions, was always higher than

* Extracted from a chapter of the book "Fatigue of Metals," edited by Professor J. A. Pope, shortly to be published by Chapman & Hall, Limited. The Author is research manager, British Cast Iron Research Association.

the top half, the averages for 20 bars being 18.6 and 18.0 tons respectively.

The suitability of hollow cylinders as a basis for preparing numerous test-bars of uniform quality has also been investigated at the British Cast Iron Research Association. Hollow-cylinder castings may be regarded as infinite flat plates, the only variation being from the outside to the inside. Such castings appear satisfactory, provided the thickness of the cylinder does not exceed about 1¼ in., but on large cylinders variations as great as 13 per cent. of the average were found amongst specimens cut longitudinally.

These results emphasize the need for caution in interpreting test data on cast iron and in comparing the results of different investigators.

Section Size and Test-piece Size

The normal mechanical properties of all cast irons decrease with increasing section size. The variation of fatigue properties with increasing cast section has not been systematically investigated, but they would be expected to decrease in a similar manner. The logarithm of the tensile strength varies linearly with the logarithm of the diameter for cylindrical test-bars.

Information available on the effect of test-piece size on the fatigue properties of cast iron indicates that, as with other materials, the limiting fatigue stress decreases as the size of the test-piece increases. When using test-pieces 1-in. dia., Eagan[10] obtained low endurance-ratios of 0.27 to 0.35. These low limiting fatigue stresses compared with tensile strengths he attributed to the use of a large test-piece. Most endurance ratios reported in the literature for bending fatigue tests have been determined on bars approximately 0.3-in. dia. and have given endurance values considerably above this range. In tests on nodular irons, Eagan[11] has also obtained lower endurance ratios with 1-in. dia. than with 0.35-in. dia. test-pieces.

Majors[12] also tested annealed nodular iron using test-pieces of 0.19 to 0.45 in. dia. in a rotating cantilever fatigue-testing machine and found a progressive reduction in limiting fatigue stress with increasing diameter of test specimen, as indicated in what follows:—

0.19 in. dia. — 16.1 tons per sq. in.
0.32 in. dia. — 14.0 tons per sq. in.
0.45 in. dia. — 13.5 tons per sq. in.

Test Details

Cycles to Determine Limiting Fatigue

Several investigators have proposed a life of 10 million cycles of stress for the determination of limiting fatigue stress for cast irons. For push/pull fatigue tests on grey irons with various mean stresses, Pomp and Hempel[13] used between two and three million reversals, but for bend tests on the same materials they used up to 13 million cycles. Grant[14] found many failures at above 10 million cycles in rotating-cantilever fatigue tests on grey cast irons and in consequence he and his collaborators have always used 20 million cycles. Grant reported very few failures at more than 20 million cycles even though some tests were continued to as many as 100 million cycles.

Speed of Testing

As with many other materials, there does not appear to be much effect on fatigue strength by increasing the frequency of stress cycles up to about 30,000 r.p.m. Krause[15] reported a 10 per cent. increase in endurance limit on increasing the speed from 10,000 to 30,000 r.p.m. for unnotched grey-iron specimens in bending fatigue, but with notched unalloyed grey irons he obtained only a slight increase, and with alloyed grey irons he obtained a slight decrease.

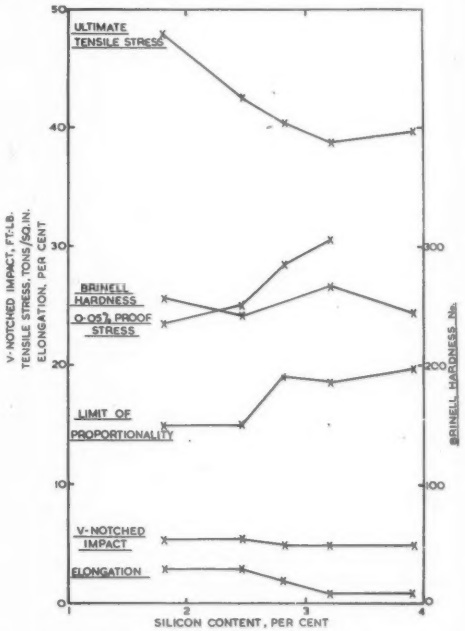


FIG. 1.—*Influence of silicon on general mechanical properties of as-cast nodular irons.*

Endurance Rates and Limiting Fatigue Strength

Fatigue properties of cast irons have often been discussed in terms of the endurance ratio, which is:—

$$\frac{\text{limiting fatigue stress}}{\text{maximum tensile stress}}$$

In most cases, the fatigue strength has been determined by rotating and repeated bending, but the ratio has still been expressed in this manner. For bending fatigue tests, wide variations in the endurance ratio have been reported, varying between 0.33 to 0.57.[16, 17, 5, 18] This wide diversity of value is related to the limitation of this method of expressing the fatigue strength, to the wide range of

materials, and to the various testing conditions. However, Grant[14] tested flake-graphite cast irons of a wide range of composition and mechanical properties, using the same machine and identical test-pieces and testing conditions, but he found somewhat less scatter and a definite trend to lower endurance ratios with higher strengths. His results are summarized in Table I, for unnotched rotating-cantilever fatigue tests.

The value of endurance ratios and limiting fatigue strengths for unnotched specimens is only of restricted interest. They give no information about the effect of mechanical or chemical stress-raisers, or the ability to withstand overstress. Nevertheless, endurance ratios are often quoted for flake-graphite grey cast irons and great caution is needed in their interpretation. The calculated breaking strength for a grey cast iron tested in bending, for instance, is always greater than the actual tensile strength, and, indeed, is often double the direct tensile strength. This is because normal

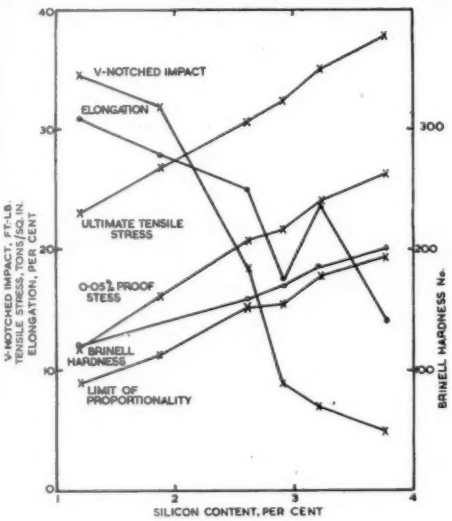


FIG. 2.—*Influence of silicon on general mechanical properties of heat-treated ferritic nodular irons.*

flake-graphite cast irons do not behave elastically and the usual formulae for calculating stresses do not apply. Grant[14] has discussed this matter in detail and has shown that for bending-fatigue tests the calculated limiting fatigue stress could be 25 per cent. higher than the actual value. The error in endurance ratio would depend upon the deviation of the actual stress from the calculated stress; this deviation will vary with the quality of the iron and the dimensions of the specimen. Thum and Ude[16] found the error was 10 per cent. of the calculated fatigue strength in an 11-ton-tensile iron and 8 per cent. in an 18-ton-tensile iron.

TABLE I.—*Rotating Fatigue Tests on Unnotched Specimens of Flake-graphite Irons.*

Type.	Ultimate tensile stress, tons per sq. in.	Limiting fatigue stress, tons per sq. in.	Endurance ratio.
Pearlitic	18.3	8.5	0.46
	18.8	8.5	0.45
	21.7	9.5	0.44
	23.6	10.5	0.45
Acicular	28.5	11.0	0.39
	29.1	11.0	0.38
	29.4	11.5	0.39
	33.9	11.5	0.34

In the case of fatigue tests on malleable and nodular cast irons, very little difference would be expected between the true and calculated stresses, as these materials have an almost linear relationship between stress and strain to stress above the limiting fatigue stress. The data available for malleable iron does show some discrepancies, however.

From these considerations it is to be expected that the fatigue limits and endurance ratios determined in an axial tensile/compression fatigue test would be lower than in bending, as the fatigue stresses here are the true ones. Push/pull fatigue tests by Pomp and Hempel[13] gave endurance ratios for several grey cast irons of 0.25 approximately and for two malleable cast irons the values were similar. Collins and Smith[8] found the ratio of endurance limit for axial loading to endurance limit for bending to vary between 0.59 and 0.94. Mahin and Hamilton[49] found an endurance limit of 0.54 for rotating-bending fatigue tests on blackheart malleable iron. Pomp and Hempel used a whiteheart malleable cast iron but the difference in endurance ratio for push/pull tests on their material compared with the bending fatigue endurance ratio found by Mahin and Hamilton suggests that stress calculations in malleable cast iron are subject to the same difficulties as grey cast iron. Pomp and Hempel[13] found the average ratio for the endurance ratio in push-pull to the endurance ratio in bending fatigue was 0.527. Collins and Smith[8] found the ratio of endurance in unnotched torsion tests to endurance ratio in unnotched bending tests varied from 0.85 to 1.22.

Notch Sensitivity

Flake-graphite Cast Irons

There seems to be fairly general agreement that the introduction of a stress-raiser in the form of a notch, groove or diametrical hole has little effect on the fatigue strength of low-strength cast irons, but, as the tensile strength increases, notching has an increasingly deleterious effect, as the results by Kommers[17], Table II, show. Grant[14] obtained

TABLE II.—*Influence of Notching (Kommers) in Relation to Tensile Strength.*

Tensile strength, tons per sq. in.	Endurance limit, unnotched, tons per sq. in.	Endurance limit, notched, tons per sq. in.	Fatigue-stress reduction factor.
8.9	4.1	4.1	1.00
11.2	5.3	5.1	1.05
13.3	6.7	6.1	1.10
15.0	9.8	7.0	1.40
16.3	8.7	7.3	1.20
19.0	10.4	8.5	1.26

Fatigue of Cast Iron

similar results with a value of 1.35 for the fatigue stress reduction factor for an acicular iron of 33.9 tons per sq. in. ultimate tensile stress with a 45 deg. V-notch and 1.28 for a groove of root radius 0.05 in.

Collins and Smith[8] carried out an extensive investigation on pearlitic, acicular and austenitic cast

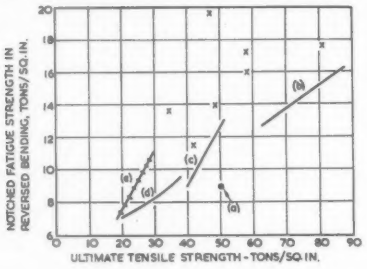


FIG. 3.—*Notched fatigue properties of nodular- and flake-graphite irons compared with other materials* (*Bailey*). (*Based on tests on small specimens.*)

Comparative results for wrought steels are indicated thus: (*a*) graphitic cast steel; (*b*) cast alloy steels; (*c*) nodular cast iron, as cast; (*d*) nodular cast iron, heat-treated; (*e*) flake-graphite grey cast irons.

iron, using bending and torsion tests; they found the fatigue-strength reduction factor increased with increasing tensile strength for bending-fatigue tests, but in torsional-fatigue tests a high fatigue-strength reduction factor was obtained with a low strength and a high-strength iron.

Malleable Cast Iron

Russell and Welcker[26] tested four malleable irons using sharp square notches and obtained fatigue-strength reduction factors of 1.37 to 1.52; a hardened malleable cast iron gave a value of 1.64. Cornelius[50] obtained fatigue-strength reduction factors of 1.42 and 1.6 for two malleable irons tested in bending, and for torsional fatigue tests on malleable irons obtained fatigue-strength reduction factors of 1.36 and 1.4. For bending fatigue, Cornelius obtained endurance ratios of 0.5 and 0.45 and for torsional fatigue he obtained endurance ratios of 0.42 and 0.38. The tensile strengths of the malleable irons tested by Cornelius ranged from 19.4 to 20.3 tons per sq. in.

Crankshaft Applications

Comparing the fatigue properties of the acicular iron, nodular cast iron and cast alloy-steel crankshafts, Bailey[4] has quoted the results obtained by Love, which show the nodular cast iron to be about 15 per cent. stronger than acicular flake-graphite irons. According to Bailey, the torsional fatigue properties are, however, more important for crankshaft applications. From the work of Cornelius[50] and Collins and Smith[8], he has contrasted the notched torsional-fatigue properties of various wrought steels, cast steels, malleable cast irons and flake-graphite cast irons. The ratio of notched torsional-fatigue strength to ultimate tensile strength was about 0.18 for the steels, 0.29 for the malleable cast irons and 0.33 for the flake-graphite cast irons. Bailey has pointed out that this might explain the relatively good service performance of flake-graphite cast iron crankshafts, but on account of the large scale-effect in notched torsional fatigue these values are likely to be all lower for larger shaft diameters.

Nodular Irons—Endurance Limit and Notch Sensitivity

Nodular cast irons are generally used in the pearlitic condition, either as-cast, normalized or

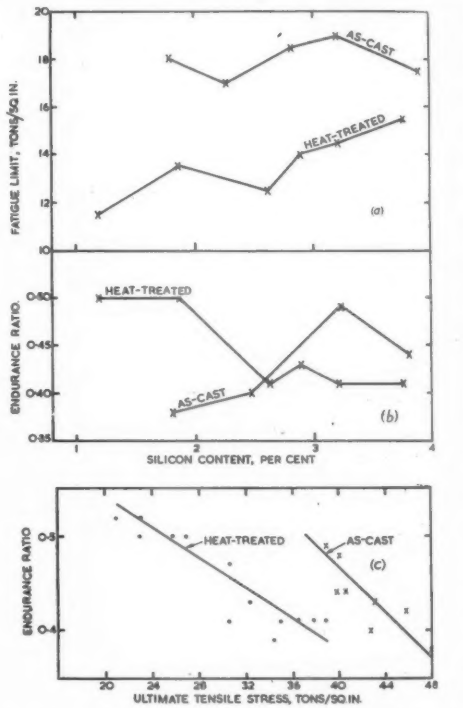
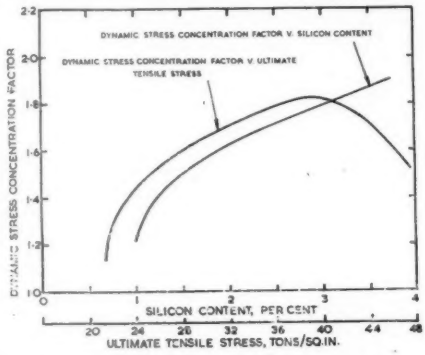


FIG. 4.—*Fatigue-test results for nodular irons* (*a*) *fatigue limit* v. *silicon content;* (*b*) *endurance ratio* v. *silicon content, and* (*c*) *endurance ratio* v. *ultimate tensile strength.* (*Palmer and Gilbert.*)

in the ferritic condition after annealing. Many elements of the composition influence the mechanical properties of these irons, but perhaps the influence of silicon is the most important. Fig. 1 illustrates the influence of silicon on the properties of pearlitic as-cast nodular irons, and Fig. 2 gives the effect of this element on the properties of the ferritic annealed material. When impact resistance

is also an important requirement, the silicon content will generally not be greater than 2.3 per cent., but in many applications where fatigue is important, impact-resistance is unimportant, so that the whole range of silicon contents are significant in this context.

Palmer and Gilbert[19] have carried out many rotating-bending fatigue tests on as-cast and annealed nodular irons, using notched and unnotched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DYNAMIC STRESS CONCENTRATION FACTOR
SILICON CONTENT, PER CENT
ULTIMATE TENSILE STRESS, TONS/SQ.IN.

FIG. 5.—*Notch sensitivity of nodular irons* (*Palmer and Gilbert*).

test-pieces. Bailey [4] has made an interesting comparison of the notched fatigue properties obtained by Palmer and Gilbert and various other ferrous materials and his results are reproduced in Fig. 3. These investigators' results are summarized in Fig. 4 for unnotched specimens; they found fatigue-stress reduction factors ranging from about 1.2 to 2 as shown in Fig. 5, thus confirming the earlier findings of Grant[14], Eagan & James[20] and Majors[12] that nodular irons are more notch. sensitive than normal flake-graphite cast irons. Bailey[4] has pointed out the need for notched torsional-fatigue test data for nodular iron and suggests that for large sections it would be unwise to assume a value greater than 15 per cent. of the ultimate tensile strength.

Under-stressing and Over-stressing

Over-stressing in a fatigue test is stressing above the fatigue limit, while a material is under-stressed if subjected to cycles of stress below the fatigue limit. Various workers have concluded from fatigue tests on over-stressed and under-stressed steel specimens that the fatigue limit is not a fixed quantity but depends on the previous stress history of the specimen. Progressively increasing under-stress may increase the fatigue limit. A small degree of over-stress for a relatively short period may produce damage resulting in a decreased endurance limit and the damage will increase with stress and number of cycles. This damage, however, if not too far advanced, can be repaired by subjecting the specimen to progressively increasing under-stress. In this way, the material may be restored to its original or an increased endurance limit.

(a) Under-stressing

The few under-stressing tests which have been carried out on cast irons have been on what to-day would be regarded as weak flake-graphite cast irons. On both pearlitic and ferritic materials, remarkable increases in fatigue limit have been reported. Kommers[21, 22] determined how the endurance limit varied with the number of cycles of under-stress. He tested a cast iron with a tensile strength of 8.9 tons per sq. in. and under-stressed a batch of specimens for a certain number of cycles before determining the fatigue limit in the normal way. His results are shown in Fig. 6. The fatigue limit increased with the number of cycles of under-stress up to a maximum of 25 per cent. The fatigue limit of this material was originally 4.1 tons per

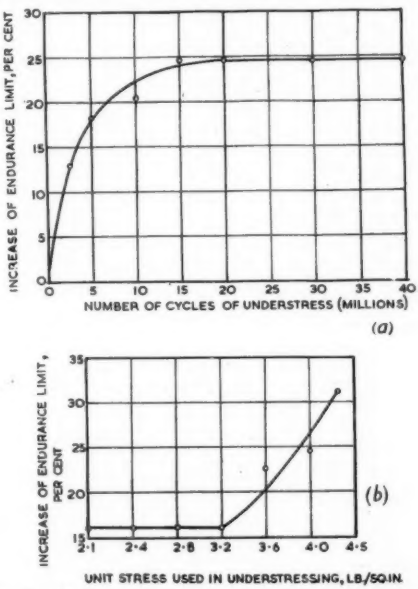
INCREASE OF ENDURANCE LIMIT, PER CENT
NUMBER OF CYCLES OF UNDERSTRESS (MILLIONS)
(a)
INCREASE OF ENDURANCE LIMIT, PER CENT
UNIT STRESS USED IN UNDERSTRESSING, LB/SQ.IN.
(b)

FIG. 6.—*Influence of under-stressing flake-graphite irons* (*a*) *effect of number of cycles and* (*b*) *effect of unit stress.* (*Kommers.*)

sq. in. and under-stressing was carried out at 4.0 tons per sq. in. The effect of varying the under-stressing stress is shown in the lower diagram. The greatest increase in fatigue limit is obtained by under-stressing at the normal fatigue limit.

A few under-stressing tests have been carried out at the British Cast Iron Research Association on a pearlitic flake-graphite cast iron and on a ferritic and pearlitic nodular cast iron. The results are given in Table III. In all cases, the under-stressing was carried out at a stress 0.5 tons per sq. in. below the fatigue limit. These results show the pearlitic flake-graphite iron and the nodular irons to be unaffected by under-stressing. These results do not agree with those of Kommers. However, the irons tested at the BCIRA had relatively high tensile

Fatigue of Cast Iron

TABLE III.—*Effect of Under-stressing on the Fatigue Limit.*

Material.	Tensile strength tons per sq. in.	Fatigue limit (tons per sq. in.).		Increase in fatigue limit, per cent.	Remarks.
		Not under-stressed.	Under-stressed.		
Pearlitic Flake iron	18.7	8.75	8.75	Nil	Unnotched.
Pearlitic Nodular iron	44.2	19.0	19.0	Nil	Unnotched.
		12.5	12.5	Nil	V-notched.
Ferritic Nodular iron	26.5	13.5	13.5	Nil	Unnotched.
		10.0	10.5	+5	V-notched.

strengths and all but one had nodular and not flake-graphite structures.

(*b*) *Over-stressing*

Very little information is available on the effect of over-stressing on the fatigue strength of cast iron. Kommers[21] carried out a series of tests on a cast iron and over-stressed at stresses up to 1.3 times

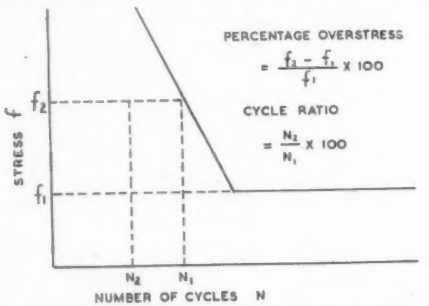

FIG. 7.—*Definition of over-stress.* (*Kommers.*)

the endurance limit. Fig. 7 illustrates how the tests were carried out. Specimens were stressed at a stress such as S_2, which was a certain percentage above the fatigue limit. This percentage gave the degree of over-stress. The number of stress cycles, N_2, to which the specimen was subjected was quoted as a percentage of the total number of cycles possible and called the cycle ratio. After subjecting a batch of specimens to a certain over-stress at a given cycle ratio, a fatigue test was carried out in the normal way and the new endurance limit found.

The results of Kommer's tests are shown in Table IV. The tensile strength of the material was 15 tons per sq. in. This cast iron showed a remarkable ability to withstand over-stress in the notched condition. Over-stresses of 10 per cent. for cycle ratios up to 80 per cent. did not appreciably affect the fatigue limit of unnotched specimens. With higher over-stress, however, there was a significant decrease in fatigue limit, which amounted to 18 per cent. at a 30 per cent. over-stress for an 80 per cent. cycle ratio. Other examples of over- and under-stressing on grey iron and malleable iron have been given by Russell and Welcker[26].

TABLE IV.—*Percentage Change in Endurance Ratio due to Over-stressing (Kommers).*

Over-stress.	Unnotched. Cycle ratio,			Square notch. Cycle ratio,		
	Per cent.			Per cent.		
	20	50	80	20	50	80
10 per cent.	− 1	− 2	− 3	+ 5	+ 4	+ 3
20 per cent.	− 8	− 8	− 9	+ 1	0	+ 1
30 per cent.	−11	−14	−18	+ 5	+ 4	+ 3

Unnotched fatigue limit before over-stressing = 9.82 tons per sq. in.; notched fatigue limit before over-stressing = 7.01 tons per sq. in.; Chemical composition:—T.C. 3.57; Si 1.58; Mn 0.58; S 0.06; and PO. 66 per cent.

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Shipbuilders' Big Reconstruction Plan

Major reconstruction of the Birkenhead shipyards of Cammell Laird & Company, Limited, was announced by the board last week. It is expected that the complete programme will take about eight years and will cost about £17,000,000. It is anticipated that modernization of plant and equipment will not only place the company in a strong competitive position but enable it to build ships of considerably greater tonnage than is at present possible.

The directors estimate that the company will be able to provide a substantial part of the funds required from its own resources, and they do not expect to approach the market for further capital in the immediate future.

Advantages of Cast Parts*

By Prof. Dr.-Ing. W. Peppler

Following a survey of the historical development of metal founding, the many possibilities of shaping cast parts are discussed. Two crankshafts are selected as examples for comparison of production either as castings or by forging, with their respective weights and costs compared. Illustrations were given to show the latitude and freedom permissible as regards design and size by utilizing the many useful properties of cast parts.

Historical Review

When man first succeeded, about 2300 B.C.—and later in Europe, about 1900 B.C.—in smelting copper and alloying copper with tin, it can be assumed that the art of making castings was acquired simultaneously, since the much older skills of working stone and of baking moulded clay or loam had already been fully mastered. During the Hallstatt period, from about 1000 to 700 B.C., the hearth process produced a low-carbon iron which could only be worked by forging and this metal displaced almost completely the use of bronze in Europe. However, man had still to attain higher temperatures by constructing better furnaces which made the carburizing of the iron possible, thereby obtaining liquid iron instead of the pasty, slag-containing bar—suitable only for forging—and the way was prepared for the melting of cast iron. This state of development existed about 200 B.C. in China, as verified by the beautifully shaped cast-iron vases and such like objects produced by early Chinese moulding and casting technique.

The casting of iron started in Germany about A.D. 1350 and developed there quickly to artistic levels even for such common articles as stoves. In 1497 sufficient progress had been made to cast a 13½-ton bell for Erfurt cathedral.

Soon, cast iron was being used for complicated and large castings more especially for parts under compressive stress. J. Hanbury and J. Payne built the first rolling mill in 1728 in England, and H. W. Remy followed in Germany in 1773. The first bridge exclusively made of cast iron, the Coalbrookdale bridge (Fig. 1) was built in 1779 to span the River Severn, having a length of 100 ft. It was constructed entirely from cast-iron elements which relied upon the iron's high strength in compression. This bridge was followed by many of similar type until 1850, when the first bridges using rolled wrought iron as a material for construction were built. The birth of steel production and the rapid expansion of industrialization would have been impossible without the aid of light and heavy machinery castings.

* Abstracted by Dr. O. P. Einerl from the introductory lecture of the symposium "Design and Casting," which formed part of the proceedings of the International Foundry Congress held in Düsseldorf, last September.

Further Advances

At the present period, which is witnessing the eclipse of the steam and large gas-engines by other sources of power, one should acknowledge the skill and boldness of former designers and foundrymen. These pioneers before the end of last century, had already mastered the production of complicated frames and rolls for rolling mills, large gas- and steam-engines, ships' engines and other driving units for large power supply. Further steps towards higher quality were made possible by rapid advancement in metallurgy. The development of welding methods and welded constructions was followed after the first world war by the development of pearlitic cast irons, improvements to malleable cast iron, high-speed steels, complex alloy steels and high-strength cast irons.

A considerable increase in the number of cast copper-base alloys took place, many aluminium and magnesium casting alloys had to be evolved to form the basis for the creation of the aircraft industry, for motor transport and other light constructions generally, improved zinc-base casting alloys came into being and the existence of low-melting-point alloys stimulated new moulding and casting processes. At the same time, practical foundry experience widened and scientific principles were applied in order to formulate rules for the casting of metals.

Freedom of Design

Designers can make full use of freedom of design in shaping his castings in many ways. For comparison of cast parts with other forms of construction, the former can be divided into three main categories:

Group A. Castings consisting of several walls, either open or closed, ribs, *etc.* These castings are in strong competition with fabricated constructions made from rolled sheet suitably shaped by deformation and welding.

Group B. Massive castings—these have to be considered relative to forgings.

Group C. Castings with complicated hollow spaces—these have to be considered in comparison with parts machined from the solid, simple assembly of machined components or a combination of these methods with welding.

Advantages of Cast Parts

GROUP A
Cast Walls and Ribs

"Thin" walls are almost unobtainable by the casting process, the word "thin" being a relative definition which must always be related to size and shape of the surfaces. Excluding small castings which can be produced either as cored die-castings, pressure-die-castings, light-metal sand castings, malleable cast iron or high-quality thin-walled steel castings, one has to admit that wall thicknesses of $\frac{1}{4}$, $\frac{3}{16}$, $\frac{1}{4}$-in. or even more for large surface areas, are the undisputed field of sheet, medium-plate and heavy-plate mills. However, many difficulties occur in sheet-metal working when surfaces and walls are not plane, cylindrical or conical, these difficulties increasing with wall thickness. Thin-walled parts can be made from sheet by deep drawing or deep pressing and the limitation of this manufacturing process, which starts from even thickness material, is indicated by the fact that the shaping by drawing, reducing, pressing, even by bending and folding results in uneven wall thicknesses and the sheet often becomes thinner at a position where full thickness or even increased thickness is desirable. At the same time, local changes of tensile strength, yield point and elongation characteristics will take place, which, in certain circumstances, can cause embrittlement, ageing or stress corrosion if the shaped sheet is not subjected to an annealing process.

At the upper limit of sheet thickness of about $\frac{3}{32}$ in., the possibilities of deep drawing are considerably restricted. Beyond this thickness, good-quality plate still permits some cold working, *e.g.* cold flanging the edges of container bottoms is possible with a ratio of inner curve radius to plate thickness of 3.4 or even 4. A ratio of about 5 per cent. between wall thickness and diameter is still regarded as permissible when thicker boiler shells are flanged cold. However, such heavy permanent deformation must certainly be followed by stress-relieving.

Hot-forming of plate is limited to cylindrical or conical shapes, flat-flanged bottoms and dished bottoms with limited ratios of depth to diameter and corner radius to diameter. Various shapes such as furnace tubes with neckings and bulgings, manhole parts, flame tubes, parts for boiler-stack flues and fire-boxes can also be produced, but require expensive tools, which make standardization essential. For very large wall thicknesses only progressive partial shaping (dishing) is possible. Complicated or very large parts from plate are being made at present almost exclusively from sections joined by welding.

In contrast to the foregoing, moulding and casting permit the production of curved surfaces of any shape with constant wall thicknesses and with relatively no limitations being imposed by the casting process. The designer can plan even thicknesses, or adjust the dimensions to suit the intended use especially as regards working conditions of stress, scaling, corrosion, erosion and general wear. These advantages become more economical the more complicated the shape of each individual wall, the greater the depth of arches, or when small frequent changes of ratio of the radius of curvature to wall thickness are required.

Cast *v.* Welded Constructions

Parts which consist of several or many walls, ribs and such-like can be designed either in an open skeleton manner or in a closed box-shape way. The latter method is always superior from the point of view of stiffness, appearance and neatness. The resulting part is in this case not necessarily heavier but may even be lighter when the stiffness of closed shapes is skillfully utilized. Price and ease of production usually dictate the simpler arrangement. For such parts, construction from sheet or from rolled or drawn semis, joined mainly by welding, has to be taken into consideration as opposed to casting. In comparison with welding, casting of a part with many walls and ribs can immediately produce it in one piece. At the design stage, the production requirements must be given thorough consideration and the designer should have full knowledge both of welding and of casting principles or he will find it necessary to consult the welder in one case and the

FIG. 1. — *The Coalbrookdale bridge spans the river Severn, having a length of* 100 *ft. It was constructed entirely of cast-iron sections in the year* 1779.

foundryman in the other. The points to be considered for castings are: Easy and safe moulding, few well placed and adequately vented cores which can be simply and efficiently removed, minimization of metal accumulations at joints of walls and ribs which may result in shrinkage trouble, due regard being paid to securing close-grain metal and eliminating contraction and casting stresses.

In comparison with welded constructions, the advantages of cast parts are: In the welded construction all eyes, bosses, reinforcements, etc., must be welded on and must therefore be accessible, whereas it is usually quite easy to cast these and to shape reinforcements such as ribs and flanges integrally. The welded construction has a harsh angular appearance which can only be mitigated at an appreciable increase of cost by bending or machining the edges.

GROUP B

Massive Parts

The evaluation of massive castings may be restricted to steel and spheroidal-graphite iron castings in comparison with forgings. In the first case, large divided crankshafts for Diesel engines will be discussed and in the second a solid crank-shaft of medium size for a Diesel engine.

Cranks and Crankshafts

Cast-steel cranks are generally cast either from open hearth or electro-furnace steel, using a larger feeder-head than would be necessary for cast iron. Apart from this, machining allowance is only provided on the machined faces. The bore can be formed during casting by coring out, or the item can be cast solid and machined afterwards. After casting, and the removal of runners and risers, the cast crank is annealed, fully machined inside and on the faces, then shrunk on to forged trunnions which have already been finished machined with the exception of a small machining allowance on the bearing surfaces. Finally all bearing surfaces are finished machined and ground and the flanges and oil-lubricating holes are drilled.

Several forged crankshafts are produced from one large bloom first formed into a bar, the cross-section of which corresponds with the circumference of the cheeks of the crank webs; this is followed by annealing. After machining of the bars to the final dimensions of the cheeks the next operation consists of drilling the base for the openings of the throws and making two saw cuts, then the cranks are separated, the bores prepared and the pieces are finally fully machined inside and outside before the crank pins are shrunk in.

A comparative calculation for two seven-throw divided crank shafts, with a pin diameter of about 20 in. is given in Table I.

The difference in price is partly due to the reduced weight of liquid steel initially required, partly to reduced annealing and machining costs and the respective overheads connected with these. From the point of view of quality, crankshafts produced either way are fully satisfactory, as shown by constant supervision of mechanical values obtained from them over long production periods*.

TABLE I.—*Comparative Cast and Forged Seven-throw Crankshafts.*

—	Arrangement A.		Arrangement B.	
	Crank-pin forged.	Crank as steel casting.	Crank-pin forged.	Crank forged.
Weights:				
Liquid steel	92 t	ons	128.6	tons
Blooms	42.6 tons	—	42.6 tons	86 tons
Rough weights	30 tons	31.5 tons	30 tons	56 tons
Finished weight	38.2	tons	38.2	tons
Costs:				
Cost of material (less credit for scrap)	£4,500		£4,640	
Cost of forging and annealing	£640		£710	
Cost of machining	£2,240		£2,560	
Overheads, profit, etc.	£4,220		£4,730	
Total price	£11,600		£12,640	
Saving of expenditure in the "cast" arrangement	8 per	cent.		

TABLE II.—*Spheroidal-graphite Iron versus Forged-steel Crankshafts.*

	Case A S.-g. cast iron.	Case B Forged (in one piece).
Weights:		
Liquid iron	24 cwt.	—
Weight of bloom	—	74 cwt.
Rough weight	13 cwt.	55 cwt.
Finished weight	9.8 cwt. or 82 per cent. of the forged weight (Case B)	12 cwt.
Yield	41 per cent.	16 per cent.
Costs:		
Cost of material (less credit for scrap)	£34 10s.	£73
Cost of forging and annealing	—	£32
Moulding, casting, fettling and annealing	£126	—
Cost of machining	£220	£370
Overheads, etc.	£84	£125
Total cost	£464 10s.	£600
Saving by producing as a casting	22.4 per cent.	—
Mechanical properties:		
Tensile strength (tons per sq. in.)	42.1	32.6
Yield point (tons per sq. in.)	33.6	18.5
Elongation per cent.	1.5	23.5

A second example relates to two six cylinder diesel engine shafts, one of which (Case A) is made in spheroidal-graphite cast iron, the other (Case B) is forged in one piece. The most important data are shown in Table II:

The crankshaft cast in s.-g. iron is therefore superior to the forged shaft in two respects: A higher yield point together with sufficient elongation for endurance and secondly a damping capacity which lies between that of cast iron and steel. The cast crankshaft has also a better shape.

The figures given in the two examples cannot be applied generally, partly because the cost of a forging will vary as to whether suitable blooms are available in stock and whether one or more pieces can be forged from one bloom. Foundrymen can, however, independent from such considerations, choose runners and risers in accordance with experience so that they should always get castings at an economic price from the metal melted.

GROUP C

Parts with Complicated Cores

In the third group, there is an infinite variety of shapes which generally have a compact exterior

* See F. Sass: "Cast-steel Cranks for the Shafting of Large Diesel Engines," *Konstruktion* 5 (1953) No. 1. pp 1 to 4.

Advantages of Cast Parts

with an interior consisting of a few or a multitude of cavities depending on their ultimate use. To provide a neat appearance, the outside contours do not necessarily follow the shape of the internal cavities so that the walls may have considerable variations in thickness. These thickness variations prohibit the production of the parts by fabrication from plate. The necessity to produce the parts economically rules out their production as forgings, since the cavities would entail considerable machining.

It would appear possible by the casting process to produce any shape previously designed as a forging, likewise it is possible to cast parts which cannot be forged and are unsuitable for production from plate. In some cases, parts are of such irregular shape as to entail the most complex machining operation, so that it is better to produce them as separate units followed by further assembly or welding together.

For the majority of parts of this nature the most satisfactory method of production is by casting. It is possible to produce castings which are of such heavy weight that they could not be made in one piece as forging or have dimensions which have to satisfy extraordinary requirements: Iron castings weighing more than 50 tons and steel castings of more than 100 tons are no rarity to-day. (What is claimed as the largest steel casting so far produced, a roll housing which was exhibited at the GIFA at Düsseldorf, was described in FOUNDRY TRADE JOURNAL, January 17 issue.)

Desulphurization of Pig-iron with Calcium Carbide

A new desulphurizing process, carried out in the ladle, makes it possible to use for the treatment of blast-furnace iron, the reaction:—

$$CaC_2 + S = CaS + 2C$$

similar to that when using calcium carbide as a desulphurizer in the electric furnace. It is necessary, however, to use an inert carrier gas to inject the carbide under the slag in the ladle. Air Reduction Sales Company, an American firm, is reported to have tested the process on 40,000 tons of blast-furnace iron and open-hearth steel over the last year and half, according to the journal "Steel." Tentatively, the process is considered reliable and practical with melts having a high sulphur content. It was recently described by J. M. Crockett, at a meeting of the Eastern States Blast Furnace and Coke Oven Association, the author pointing out that theoretically, it should take about 2½ lb. of carbide to remove 1 lb. of sulphur, but in tests the process operated at from 6 to 23 per cent. of this level. On average, it took about 8 lb. of carbide to bring down the sulphur in a ton of iron to about half its level before treatment. The process, it is reported, was most efficient when the initial sulphur exceeded 0.030 per cent.

FOUNDRY SERVICES, LIMITED, Birmingham, will have a working steel furnace on its stand at the British Industries Fair. It is believed that this will be the first time that the simulation of foundry working has been presented at any exhibition.

Consett Iron's Dividend

Speaking at the company's annual meeting at Newcastle-upon-Tyne on February 5, Mr. Clive Cookson, chairman of the Consett Iron Company, Limited, said he was quite aware that shareholders would have liked a bigger dividend than that forecast when the shares were offered for sale by the Iron and Steel Holding and Realization Agency. But the board had decided after careful consideration that there was no alternative other than to consolidate the company's finances after denationalization.

Mr. Cookson said there was a further compelling reason for conserving resources: the continued increase needed in steel requirements if this country was to hold its own. On that point all authorities concurred. One of the great shortages was in flat-rolled products, and the company's plate mills, while producing good plate, were old and costly in maintenance.

Mr. Cookson further outlined the company's production needs, pointing out that there were improvements to be made, the total cost of which at the end of the year had been authorized to the extent of about £2,600,000.

Capital Expenditure in Industry

Final figures of capital expenditure in manufacturing industry in the third quarter of 1956 show that total spending was 13 per cent. higher than in the same period of 1955. Although this is slightly greater than the provisional figures suggested, it is only about half that of the earlier months of the year. The increase is accounted for by a 15 per cent. rise in expenditure on plant and machinery, 18 per cent. on building work, and a fall of 8 per cent. in investment in new vehicles.

The largest increase in capital spending for the third quarter both of 1956 and 1955 was in the chemical industry where the rise was 47 per cent. The rate increased by 22 per cent. in the metal-using industries. The trend, taking 1954 average as 100, rose to a peak of 154 in the last quarter of 1955, dropped back to 135 in the first quarter of last year, and then recovered to 144 and 150 in the subsequent quarters. The figures for the last quarter will probably show an increase on the similar period in 1955.

Gauge and Tool Exhibition

Now that the New Horticultural Hall at Westminster is no longer large enough to accommodate the space requirements of members of the Gauge and Tool Makers' Association, this year's gauge and tool exhibition—the fifth in the series—will be held in the National Hall, Olympia, from May 12 to 21.

The association also announces that the following group visits are being arranged this year for executives of member-firms:—Milan/Basle (April); Paris (June), and western Germany (September). The visit to western Germany will include a tour of engineering factories and attendance at the European Machine Tool Exhibition in Hannover.

SHEFFIELD CHAMBER OF COMMERCE will celebrate its centenary on March 5 when the Archbishop of York (Dr. Michael Ramsey) will give the address at the thanksgiving service to be held in Sheffield Cathedral. He will also be a guest at the chamber's centenary banquet.

Equipment & Supplies

Non-destructive Testing

When the fission of uranium in the Calder Hall nuclear power reactor reduces the usefulness of the uranium fuel below the economical level, the fuel rods are removed from the reactor and the waste products (residues of the uranium fission) are removed, separated and refined. These waste products are highly radioactive and find extensive use in medicine and industry. A widespread use of one of these products, Cæsium^{137}, is in industrial radiography. The radiation emitted by Cæsium^{137} may be used in the same way as that from an X-ray machine for the inspection of castings and frequently in a more efficient manner. Since the radiation is emitted continuously in all directions a large number of objects, frequently differing in type and material, may be inspected simultaneously to produce a reliable record of the inspection at low cost. This facility is specially catered for in radiographic units built by Nuclear Engineering, Limited, Greenwich Metal Works, London, S.E.7.

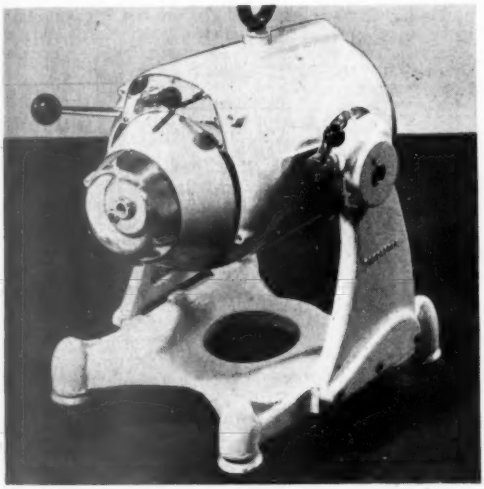


FIG. 1.—*Caesium^{137} source unit produced by Nuclear Engineering, Limited, for the non-destructive radiography of castings.*

The geometrical dimensions of a typical source are of the order of ¼ in. and the penetrating power of its radiation is roughly the same as that from a 1,000,000 v. X-ray tube; it is suitable for inspection of ferrous materials in the thickness range of ¾ to 4 in. The half-life of the source is about 30 years.

Generating Sets

A range of generating sets has been introduced by Newage (Manchester), Limited; this comprises the 2.2, 3.4 and 5.1 litre capacity diesel engines coupled to a "Stamford" alternator. This is the first time that these two equipments have been coupled together as a complete generating set, and are available with a delivery of approximately 10 weeks. Further details and specifications are available from Newage (Manchester), Limited, 6, Carlos Place, Grosvenor Square, London, W.1.

Cyclone Dust Collector

Of special interest to founders is the information that W. C. Holmes & Company, Limited, of Turnbridge, Huddersfield, have recently introduced into the country, the Holmes-Rothemuhle X multi-cell cyclone dust-collector. It is claimed that this collector presents a cheap and efficient solution to many of the pollution and dust-recovery problems arising in industry. Its efficiency is said to be derived from the small diameter of the individual cyclones which comprise the complete

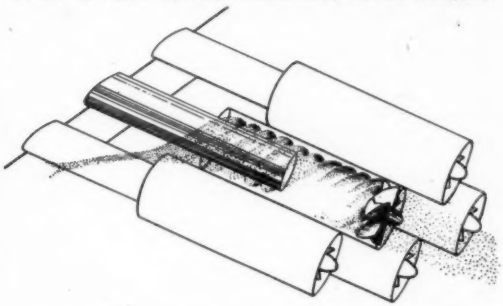


FIG. 2.—*The cyclone dust collector produced by W. C. Holmes & Company, Limited, showing the passage of the dust particles through the equipment.*

unit, this being maintained over a wide range of dust burdens and gas volumes. Each cyclone consists of two concentric tubes; an outer flue-gas cylinder with an impeller at the inlet, and an inner clean-gas tube. The intense swirl imparted to the dust-laden gas, on entry, causes the particles to be centrifuged to the annular collecting space, as is shown in Fig. 2. The dust gravitates to collection hoppers, while the clean gas passes through the inner tube to the outlet duct. Economy in space coupled with simplicity of design results in simple and economic installation and operation of the unit with no fear of blockages. It is claimed that the collector is suitable for a variety of problems ranging from the removal of fly ash from boiler-flue gases to the separation of dust in extractor systems in foundries, and the recovery of fines in mineral-preparation plants.

Wire Binding Tool

Douglas Kane Associates, 5, New Quebec Street, London, W.1, announce the production of two wire-twisting and binding tools which are suitable for all types of wire tying work, such as sack tying; wire coils; reinforcement rod tying, and cutting. Model **R** is fitted complete with an integral wire spool containing sufficient wire for 100 ties. Operation is facilitated by positioning the wire round the object to be tied and into the slot in the twisting blade, a few sharp pulls of the wooden, or plastic, handle twists the wires and at the same time cuts the ends. Model **S** is identical in operation but is not fitted with a wire spool; its use is therefore restricted for mild-steel wire from a reel, coil or in cut lengths.

Epoxy-resin Cements

The group of petroleum-derived epoxy resins have been used with considerable success in paint and lacquer formulations for industrial and commercial applications for several years. New uses are being developed depending on their incorporation in a

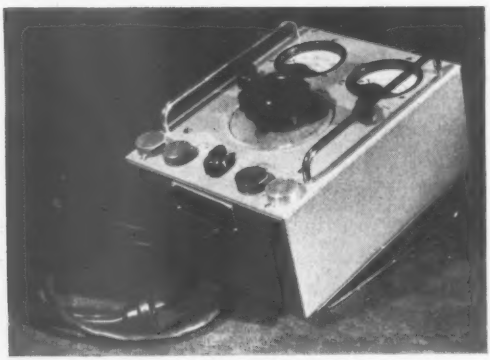
Equipment and Supplies

chemical-resistant cement for bonding acid-resisting tiles and as a thick cold setting medium. Two products recently available from Corrosion Proof Products, Limited, Sunleys Island, Great West Road, Brentford, Middx, "Corro-Proof 'PXY' cement and Corro-Proof 'PXY' resin membrane," incorporate these resins. The epoxy resins do not offer marked advantage over the more conventional furane, phenolic and cashew-nut shell resins purely from the viewpoint of resistance to chemical attack, but in respect of mechanical strength epoxy resin cements are claimed to be distinctly superior. Another feature of both products is consistency in setting; both the cement and the membrane are supplied in two parts, which as soon as they are inter-mixed commence to set and self-cure, thus setting time is not materially affected by temperature and humidity variations. Examples of their use are the cementing of lining tiles of pickling tanks in foundries and enamelling shops and the bonding of stone-ware pipe-joints in laboratory services, etc.

Metal Sorting

The Solartron Electronic Group, Limited, have introduced to the market a portable lightweight metal sorter, based on measurement of the specific resistivity of different metals. It is claimed that due to the simplicity of design and operation of this equipment, which is shown in Fig. 3, it is essentially practical and can be used by foundrymen, scrap sorters and others with little knowledge of electronics. The equipment consists of interchangeable test heads which are coupled to the instrument case; power is derived from dry batteries which are automatically compensated while in use. The range covered is one to 28 micro-ohms per centimetre cube and provided the specific resistivity of the metal lies in this range it may be identified. Additional applications mentioned by the manufacturers are testing the uniformity of coatings and claddings; detection of variations in hardness and surface flaws; locating embedded foreign matter and the detection of variations in thickness of sheets and plates from one side only. Technical data and further details may be obtained on application from the Solartron Electronic Group, Limited, Thames Ditton, Surrey.

FIG. 3.—*Shows the resistivity measurer and sorter complete with test head; it can be operated in the vertical or horizontal position.*



British Standards Institution

The British Standards Institution have recently issued two new Standards (B.S. 2811:1957) (B.S. 2741:1957) which specify requirements for the control of smoke emission. B.S. 2811 deals with smoke density indicators and recorders which, while costing rather more than the simpler alarms specified in B.S. 2740, give the furnace operator an indication of the actual density of the smoke passing up a chimney at any one moment, and can also make chart records of this. Such instruments assist in the maintenance of efficient combustion.

B.S. 2741 suggests a number of forms of simple instruments which will be found useful in certain circumstances to supplement the information given by photo-electric instruments of the type specified in B.S. 2740 and B.S. 2811. The underlying principle in these simple viewers is that a beam of light is partially obscured by a column of flue gas and either viewed directly or by reflection or on an opalescent screen. They are particularly useful in cases where an alarm or indicator is fitted on chimneys common to several furnaces. A simple smoke viewer used on each of the furnaces will then indicate to the fireman the particular furnace which is responsible for an undue emission of smoke. Copies of the standards may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Prices 3s. 6d. and 3s. respectively.

Latest Foundry Statistics

According to the Council of Ironfoundry Associations the following number of ironfoundry workers were employed in the United Kingdom during the week ending December 1, 1956:—Males, 131,182; females, 9,977, making a total of 141,159. The corresponding earlier totals were 142,031 and 146,080 for November 3, 1956 and December 3, 1955, respectively.

As reported by the British Bureau of Non-Ferrous Metal Statistics, the output of copper-base castings during November was 6,864 tons. During the eleven months of 1956, the output was 71,054 tons as against 65,519 tons in 1955, the production of pure copper castings also rose 1,350 tons to 7,150 tons.

Cast-iron Coffins

Many founders recall that one of the first uses of cast iron in the British Isles was for tombstones, but few are aware that coffins were made in this metal for the élite. In the 1840's, Gardiner's Foundry in the primatial City of Armagh, the Canterbury of Ireland, cast the first iron coffin for a nobleman. It was in the traditional shape, the lid being embossed with the peer's coat-of-arms. The casting was in two pieces, the body and the lid; the body was cast on a core case made of cast iron and perforated, this was covered by straw roping and coated with porous loam. The cover mould was also perforated cast iron lined with straw matting and pasted with blue clay to allow a space between this and the moulding case of ¼ in. The metal was poured into the inverted bottom of the coffin through a long slot forming both downgate and ingate. Very neat coffin castings were made by this method and over 14 had been cast at Gardiner's by 1849; these were used in most cases for vault burials.

MORE THAN 10,000 industrialists visited the "Gas At Work in Industry" exhibition during its ten-day run from January 22 to February 2, at the Royal Horticultural Hall, Westminster.

Pre-coated Resin Clay-bearing Sands

Writing in *Iron Age* under the caption "Improved Mould Sands Drop Shell-casting Costs," Mr. O. W. Winter (of the shell-moulding division of Beardsley & Piper, Chicago) deals *inter alia* with the use of clay-bearing sands, instead of washed silica. An abstract from his remarks is contained in the following:—

According to the Author, resin-coated sand has largely superseded the dry resin-sand mix formerly used in shell moulds, and improved cold-process coating equipment now encourages the use of the less-costly sand in low- as well as high-volume shell moulding. The successful use of clay-bearing sand is said to promise yet another reduction in costs. Here it is claimed to be satisfactory to use even sub-angular, clay-bearing bank sands, at $3 a ton, instead of materials at $10 per ton.

Resin Cost

The cost of resin for binding moulding sand undoubtedly has retarded acceptance of the shell-moulding process. Resin manufacturers have reduced prices substantially in the past five years; this has helped, but the availability of resin-coated sand probably is more significant. There has also been a slight decrease in sand cost for shell moulding. Shell moulders last year fretted over the recommended use of washed or clay-free round-grained sand which costs up to $10 per ton. Recent advances now make possible specifying sub-angular, clay-bearing sand at $3 per ton. The less expensive sand may even excel performance of the previously used material in some important respects.

Earlier, resin and sand were mixed dry with one another, just before moulding. In contrast with the results of this now obsolete technique, each particle of sand processed by new methods is coated uniformly with a thin film of resin. Other advantages include elimination of dust and separation problems, as well as reduced sensitivity of treated sand to moisture. A strong point in favour of hot- or cold-coated sands is their lower-resin content. With only half the weight of resin, shell moulds of coated sand, test to the same mould strength as those formed from dry mixes.

Hot or Cold Methods?

Two current methods exist for resin coating sand. Field installations producing hot-coated sand have operated since 1953. Equipment cost is a principal drawback to the broader use of the hot technique. Thus far, such installations have been primarily limited to high-production situations. Within the past year or so, another sand-coating method has sprung into relative prominence. This technique coats sand without use of heat, hence is referred to as the cold process.

By the use of liquid resins or water-alcohol solvents, the cold process becomes more universally applicable than the hot. Equipment at low cost, capable of coating 600 to 900 lb. of sand hourly, is available, as is high-production apparatus handling 2,000 to 20,000 lb. per hour. Some cold coating is being attempted in conventional mullers, but with results that leave something to be desired. The action of conventional mullers tends to ball the resin, rather than disperse it through the sand. Also, their mulling action usually takes longer.

To drive off all solvent volatiles, extra mulling usually is needed in standard equipment. This can and does result in chipping of the resin from the sand. In addition, resin freed by the crushing action later affects shell-mould strength. Shell moulds thus produced are weaker by a considerable margin than those made from sand mulled in especially-designed coating equipment. One recourse to avoid over-mulling, if conventional mullers must be used, is early discharge of coated sand. Then aerate the mass with hot air to drive off all volatile elements; this last step involves extra cost, of course.

Another important reduction in mould material cost involves successful use of clay-bearing, sub-angular bank sands instead of clay-free, round-grain sands. The latter formerly were thought necessary for good shell moulds. These cheaper sands successfuly resin-coat without being adversely affected by the clay content. When subsequently shell moulded, they can perform even better than the formerly used clay-free sand. Perhaps because of clay content and the sub-angular grain, clay-bearing bank sands appear to provide greater hot-strength than clay-free sands. Steel castings are now being successfully poured in shell moulds made of clay-bearing sand containing 3 per cent. resin by weight.

Current explorations into various mould mix additives will most likely bring about higher hot-mould strength than is now available. This in addition to bettering other mould properties. Of particular significance among the additives are those that may improve mould strength even beyond the temperature at which phenol-formaldehyde resin burns. Such additives not only potentially hold forth the attraction of further reduction of resin content in mould sand, but also the promise of a mould that can make better castings cheaper.

Development of fully-automatic mould- and core-making equipment now available helps lower shell moulding costs still further. One fully automatic three-pattern machine produces some 120 moulds per hour, and the one operator need only pick up the finished moulds. Another machine turns out 300 shell-moulded corebox loads of blown shells hourly.

Another trend encouraging lower shell-casting costs is the use of contour clamping. The technique employs shell moulds with specially contoured backs, usually formed by hot- or cold-blowing equipment. Mould backs press either against one another, or against metal plates with similar contours. In the latter case, the shell mould acts in effect as a liner for a permanent mould. Stack moulding typifies the other technique. In stack moulding, opposite sides of each shell serve as cope and drag

Pre-coated Resin Clay-bearing Sands

respectively for adjacent mould cavities. Such moulds can be and are being poured to-day. One automobile manufacturer currently casts valve rocker-arms in this fashion.*

Shell Core Patterns

When the contoured shell is used as a liner, forming it on a cold contour blowplate amply controls accuracy of the shell backs. In producing shells for stack moulding, forming by the hot double-pattern technique is required, when cope and drags are produced on opposite sides of the same shell.

Of even greater importance than blowing shell moulds is the fact that resin-coated sand permits blowing of shell cores. The resulting dense and strong sand structure in the blown core enables close accuracy, dimensional stability and better finish on the casting than from shell cores made by gravity-dumping procedures. Its greater strength also permits a thinner core-wall containing less resin. All this means lower core-material costs. Use of shell cores is not limited to shell moulds alone. They can be used in any kind of mould: green sand, dry sand, and permanent.

Holes produced by blown shell cores are reportedly being held to tolerances of ± 0.001 in. per inch. Since costs associated with internal machining usually are higher than with external machining, the magnitude of savings here in reduction of machining is quite significant.

Apart from better and more accurate castings, shell cores offer other foundry advantages. Being usually hollow, they vent naturally to eliminate porosity and gas blows in the castings. This hollow construction also provides important savings in use of sand and resin binder. Collapsibility of the core can be consistently and accurately controlled by varying one or more of several factors, such as resin content, degree of cure and core wall-thickness. The type of sand and additives employed can also serve to effectively govern collapsibility.

High strength of a shell core makes feasible such economies as elimination of reinforcing wires, rods and chaplets. Likewise, this strength encourages coring of smaller holes and narrower grooves than heretofore considered practical. Many holes and recesses are produced in shell castings by the simple device of protrusions on the mould face. In other forms of moulding, this would require use of cores. Holes in castings so produced include some with depth to diameter ratios of 4:1.

A shell core usually is ready for insertion in the mould as removed from the corebox. An exception exists where cores are semi-cured in the corebox, then are removed to finish curing either in a furnace or by their own residual heat.

This latter practice prevails more generally in moulding solid cores. This may occur where limitations exist on geometric shape, or with combinations of thin and thick sections—as in cores for automobile cylinder-head water-jackets. There, leaving the core in the box long enough to cure thick sections would over-cure thin sections.

Shell cores take more handling than oil-sand cores. This is because of their harder surface, hence less chafing, and their lower dead weight. Nonetheless, the less handling the better. Under no circumstances should cores be removed from the box until sufficiently cured and rigid. Generally, it is good practice to place cores directly into the moulds as they are taken from the hot corebox.

* See FOUNDRY TRADE JOURNAL, September 2, 1954.

Challenge to Shipbuilders Means More Steel

If the shipbuilding industry is to meet the challenge of the mammoth tanker, it must have additional steel supplies, said Mr. G. H. Houlden, managing director of Vickers-Armstrongs (Shipbuilders), Limited, at Barrow-in-Furness last week. He was speaking after the launching of the 32,000-ton tanker, British Glory, the first of two tankers ordered by the BP Tanker Company, Limited.

To build three 65,000-tonners in one year from the steel supplies currently being received by his company's two yards would leave very little steel indeed to meet the requirements for non-tanker tonnage, said Mr. Houlden. The industry's needs were more steel to extend fully the capacity of plants, slipways, and the steadily increasing labour force.

Viscount Knollys, chairman of Vickers, Limited, who also stressed the need for more steel, said that on the order-book for that yard there were two further vessels of 42,000 tons and three more, one of which might well be a 65,000-tonner. "This is not the end so far as we are concerned," he said. "We are examining the possibility of building tankers of greater deadweight tonnage, even of between 85,000 and 100,000 tons, as well as of increasing our dry-dock facilities for such mammoths." New methods of propulsion were also being investigated.

Sheffield Firm's £112,000 Gift For Housing

Announcing a gift of £112,000 by Samuel Fox & Company, Limited, Stocksbridge, Sheffield, to the Stocksbridge Urban Council, the chairman of the council's housing committee (Coun. A. Sweeney) said: "There are no ties, no snags, and no conditions to this very generous offer." The gift has been made for the purchase of land and the development of the sites for 500 houses and it follows 17 months' negotiations in connection with the company's £10,000,000 expansion programme and the consequent labour force required.

From the total, £12,000 is to be used towards the cost of the site, £50,000 for basic site development for an initial batch of 250 houses, and £50,000 for basic site development for the remaining 250 houses as and when it is decided to build them.

He knew of no record of a similar scheme anywhere in the country, said Mr. Sweeney, and added: "This seems to us a step in the right direction, and we are looking forward to years of prosperity and success born of the splendid co-operative spirit which now exists between this council and the company."

NEWTON CHAMBERS & COMPANY, LIMITED, of Sheffield, are showing their latest model of the Redfyre open convector fire at the "Daily Mail" Ideal Home Exhibition in March.

Bronze & Brass Founding and the Research Association*

Survey of Work Completed and in Hand at the BNFMRA

Although in the past much of the research work which the British Non-Ferrous Metals Research Association has carried out for the bronze foundry industry has been of a basic character, Mr. Mantle—in a survey of work completed and in progress given to London-area members of the Association of Bronze and Brass Founders—pointed out that this was essential because of the necessity for filling in background information about the materials being dealt with. At the time the BNFMRA started work on the casting of bronzes, data about the casting characteristics of the alloys; their behaviour towards gases; factors affecting pressure-tightness, and so on, was of the most meagre kind. Over the past years, gaps in this background information have been largely filled and it is on the basis of this fundamental work that the Association is able to help the foundryman overcome his immediate practical problems. The Association runs a technical enquiry service which is really a consulting service for the benefit of its members, and is receiving a considerable number of problems from the foundry industry, often involving visits to the foundries to give practical advice on the spot.

Practical Aspects

More recently, the work going on in the Association's laboratories has taken a very practical turn. For example, work recently published on melting losses should be of interest to all bronze foundrymen and, if the lessons from this work are learned, many foundries could make savings in their melting costs. The surveys of shell moulding and the CO_2 Process which have been carried out by Mr. Rice, of the Association's staff, in connection with the Conditional Aid scheme organized by the ABBF have surely been of great use to all foundries considering these new processes. At the moment, a similar survey is being made of furnaces for melting copper-base alloys in which about 20 firms are collaborating by collecting data about the performance of their melting equipment over a period of three months. This latest survey, which should be available for publication by the end of March, will no doubt be of still greater benefit.

The main research in progress in the laboratories at the moment is concerned with methods of running, gating and feeding castings—an important subject, since poor running and gating systems probably account for more scrap castings than any other single cause. To begin with, several of the running systems recommended by different workers were tried, particular attention being given to obtaining non-turbulent flow of metal, which is of importance in casting aluminium-bronze and high-tensile brass. The next stage was to simplify the more promising systems to make them more suitable for everyday foundry use, and the stage has now been reached where systems are being developed to bring about the flow of metal into moulds in such a way as to encourage directional freezing.

In connection with shell moulding, the experimental machine in the Association's foundry has been used, among other things, to determine the effect of shell moulding on the structure and mechanical properties of cast gunmetals and phosphor-bronzes. The conclusions reached have been that there is little difference in strength between castings made by shell moulding and castings made by green-sand moulding, but shell-moulded castings differ in structure from those made by green-sand moulding and this could account for some of the difficulties experienced with making pressure-tight castings. It is thought that turbulence in the metal, caused by the gases given off from the shell mould when the metal is first poured, might account for the difference in structure. Dimensional accuracy of castings has been studied, and it seems clear that there are variations between similar castings made on a spray in a shell mould according to the nearness or remoteness of the castings from the runner.

Specifications

In connection with the drafting of specifications for bronzes, an investigation has been made into the effect of sulphur on the mechanical properties, fluidity and pressure-tightness. In the case of leaded gunmetals, sulphur seems to be of no practical significance, but it may have a slight effect on the definition of castings made in phosphor-bronzes, though work on this aspect has not yet been completed.

Other matters which the Association is looking into, concern the casting of test-bars and materials for constructing pyrometer sheaths. With the work on test-bars, the aim is to produce a pattern which will enable more consistent results to be obtained with gunmetals and phosphor-bronzes than is the case with the test-bars at present in use.

* Abstract from an address given last month to London-area members of the Association of Bronze & Brass Founders by Mr. E. C. Mantle, M.Sc. liaison officer, British Non-Ferrous Metals Research Association.

FIRST GOVERNMENT-BUILT "Advance" factory on the Carnmoney factory estate, Belfast, is to be occupied by Light Alloy Construction, Limited, a wholly-owned subsidiary of Summerson Holdings, Limited, Darlington. The company is to manufacture a new type of collapsible aluminium freight container, and production is expected to begin in midsummer.

MACKAY INDUSTRIAL EQUIPMENT, LIMITED, has for loan copies of a 16 mm. sound film dealing with the principle and operation of the free piston engine for such applications as air compressors, motive power for ships, locomotives, automobiles, and power stations. Readers interested should write to the firm's publicity department at Faggs Road, Feltham (Middx).

Minimizing Foundry Noise

Unless it involves the drastic action of forcing people out of work, there is little more that can be done at present to minimize noise nuisance from operations in the Leith Foundry of Bonnington Castings, Limited. After hearing a letter from the firm, the Health Committee of Edinburgh Town Council decided to close the matter as far as they were concerned but to ask the firm to inform the Corporation, as a matter of courtesy, when they were introducing new equipment. Recently the Health Committee gave an ultimatum that there must be improvements within three months. The letter from the firm stated that there was nothing that could be done to lessen the noise any further when overtime was being worked. There had been a recommendation from experts in acoustics that they might enclose a certain part. For the last week or so the machinery had been stopped during the night shift. The company wished it to be clearly understood that there was nothing further that could be done to minimize the noise in the dayshift and when overtime was being worked.

The chairman, Coun. Graeme H. Menzies, said there had been several meetings of residents and it had been reported to him that there had been a great improvement in the noise nuisance. The company had done everything in their power to reduce the noise. He did not see what else could be done apart from closing the foundry altogether, which he was sure the people in Leith would not want. Bailie Cormack said he was not prepared to accept that, if the residents said everything was all right he would be satisfied; if not, he was prepared to move that action be taken for closure of the foundry.

Coun. Mrs. Woodburn said that people of Leith would not want such a step to be taken. A feeling had been expressed that the noise had been minimized, but there were still many complaints and complaints that extra noises were starting up. Bailie Cormack got no seconder for a motion in favour of closure and Coun. Kane asked that the matter be kept open.

Gas Cutter at Alston

Alston Foundry, Limited, of Cumberland, have detected a 75 per cent. saving in time in their swing grinding department as a result of the installation of a feeder-head cutting machine recently designed and supplied by British Oxygen Gases, Limited. The foundry produces steel castings for Coles mobile cranes and a substantial part of their production consists of wheel and gear blanks. Formerly, the feeder heads on these castings were partially removed by a handcutting blowpipe, and the remaining boss was removed by a swing grinder.

The machine (Fig. 1) has an electrically-driven turntable of 5 ft. 6 in. dia., which is capable of accommodating gear wheels from 1 to 5 ft. dia. A flexible drive is fitted which has a peripheral speed range of 3 to 42 in. per minute in stages of 3 in. Two machine cutting blowpipes each mounted on a standard 36-in. Universal cutting machine column and arm, are set at right angles to each other and close to the edge of the turntable. Since each feeder head on the blank not only projects vertically but also overhangs the edge of the wheel, two cuts are necessary to remove it. One blowpipe is able to make horizontal cuts, although remaining in a vertical position. The machine is operated by one man, whose first task is to set the casting squarely in the centre of the table. The required speed is then selected and the first feeder head is brought round to the horizontal cutter, this is positioned by operating the cross slide on an arm provided for lateral adjustment, and vertical positioning of the cutter is controlled by a tacking knob on the cutter. The positioning is completed in approximately one minute, and no further adjustment is required for other feeder heads on the casting.

The start of the cut is preheated for a few seconds, after which the cutting oxygen and turntable motor are switched on simultaneously and the horizontal cut made; this cut is kept flush with the side of the wheel, within a small tolerance. The turntable carries the partly-cut feeder head to the vertical cutting station, at the same time, the next uncut feeder-head positions itself adjacent to the horizontal cutting station; time is allowed for preheating, after which both cutters operate together. The vertical cut is carried very closely against the edge of the wheel blank, and the removal of the first feeder head is thus completed. By rotation of the turntable removal of the remaining feeder heads can be accomplished without further resetting.

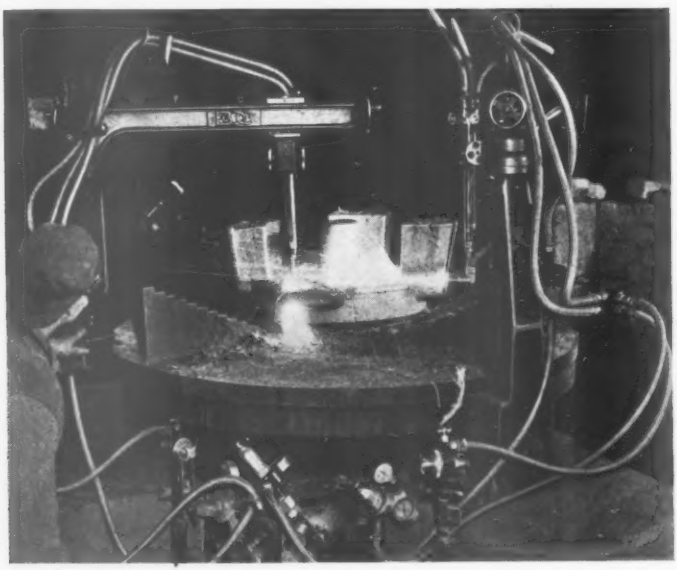


FIG. 1.—*BOC automatic cutter in operation in a steel foundry. The cutter on the right is making the first horizontal cut to remove most of the feeder-head material, the vertical cutter removes the remaining overhang. Provided the casting is set-up accurately on the turntable for the first cut, no further adjustment is required for subsequent cuts.*

Notes from the Branches

East Anglian Section

The January meeting of the East Anglian section of the London branch of the Institute of British Foundrymen had an excellent attendance to hear Mr. D. Killingworth, F.I.M., B.SC., discuss many aspects of foundry developments recently introduced. Various types of production equipment were presented by means of slides and photographs, and their advantages, disadvantages and limitations were described by the speaker. Mr. Killingworth was introduced by Mr. Wincer, section president, who said he was pleased to renew a friendship and added the speaker also had many friends in the audience.

At the conclusion of the talk a very interesting discussion resulted; it was opened by MR. CATES who referred to the dust problem in cleaning rooms and concluded by asking the speaker of his experience with the de-coring of castings by shotblasting.

MR. KILLINGWORTH replied that he had some experience of de-coring by the shotblast method and the results were quite good. As with the Hydroblast plant, the process was time consuming and required a fair amount of plant. It was a dry process involving high-pressure shotblasting within a chamber and the large amount of dust created was cleared quickly by a constant stream of air travelling across the chamber. The finished castings were dry and ready for chipping and grinding. The amount of maintenance necessary on the plant was reasonable. Sand became mixed with the shot but the latter was magnetically separated. The method undoubtedly eliminated the dust that arose from de-coring in the cleaning shops.

Additives

MR. CHILD said that many references to dust and noise within the foundry had been made, some foundries had replaced coal-dust by wood-flour as an additive to moulding sand; this would undoubtedly improve working conditions. What did the speaker think of the change and what had been his experiences ? secondly did he think that the control of the pH value in sands was worthwhile ?

MR. KILLINGWORTH said he would agree to substituting wood-flour for coal-dust to a point but considered that although 100 per cent. wood-flour was suitable for small castings it would not be so satisfactory for heavy castings. The large additions required to give good surface finish on thick sections resulted in a sand with poor ramming qualities. In his opinion half coal-dust and half wood-flour was a good compromise. Referring to the question on pH values, his experience was that it definitely paid to control this factor. Better sand properties had been maintained and bond additions saved.

MR. BASELOW asked "why replace coal-dust by wood-flour, surely they were two different materials? "

THE SPEAKER said that by choosing the sand for size and type of castings made and using only wood-flour one could obtain quite good surface finish and at the same time reduce the dust level at the sand plant. He agreed, however, that in general coal-dust was more useful to improve surface finish and wood-flour to prevent scabbing.

MR. CHILD commented that foundrywork was not an exact science, consequently variations arose from time to time, and by exploiting certain foundry developments it was possible to eliminate a large number of the variables.

Refering to the presentation of photographs of a German automatic-moulding plant for cast-iron radiator sections MR. CARRICK commented that this item was of great interest and credit must be given to the German engineers for overcoming tricky production problems encountered on this type of product. It should be noted that the large rebuilding programme in the German cities and the heavy destruction of the German factories permitted rationalization of design and sizes of radiator sections to suit the fast automatic moulding units that were being developed at the time. Adoption of these new moulding methods for the wide range of present day designs would present difficulties. MR. KILLINGWORTH added that intensive investigation into detail should be applied and gradually built up long before an anticipated change was made.

MR. CARRICK asked (i) if the speaker agreed that the general trend was for the use of plain squeeze-moulding machines with higher loading giving harder moulds wherever this method suited the work, and (ii) if special enclosed core-sand storage facilities were necessary when using the " auto-setting " core oils.

The reply to the first question was that this was the trend possibly because successful results were being achieved with an added advantage of considerably less noise and maintenance; and to the second, enclosed storage is of little benefit as the sand must be used almost immediately.

A very interesting American photograph was shown, which illustrated special equipment used to make a steel casting by the application of air pressure to a special ladle which permitted the mould to be clamped on its lid to which was fitted an asbestos seal to the ladle. The metal was forced vertically into the mould through a graphite pipe in the centre of the molten steel.

MR. BERRY referred to this method and considered that the standard bottom-pouring method would have achieved equal results.

MR. KILLINGWORTH said he did not think such an expensive piece of equipment would be introduced unless all established practices and principles had proved unsuccessful.

Scabbing Problem

MR. PEACOCK asked (i) in view of the money and time spent on the development of the engineering and scientific approach to moulding, was it not a grave indictment on how much or how little progress had been made when there was still trouble with scabs, and (ii) how, in the opinion of the speaker, did British moulding machines compare with those he encountered on the continent. Were they more efficient, were they more robust ?

In reply to (i) the speaker said he quite agreed and unfortunately for us, the position was as stated; the only way to overcome the problem of scabbing was to make the sand foolproof. It was largely a question of economics and training, for even with semi-skilled labour on moulding machines the human element still played an important part in ensuring good castings. Scabbing and other causes of scrap castings often resulted from poor sand control and it was important to review money spent to achieve the level of sand control desired.

MR. CARRICK remarked that often scabbing troubles were cured yet the problem was always " pregnant," to which the speaker replied that it was usually most economical to " sail near to the wind " and this emphasized the value of close control.

To the latter question (ii), MR. KILLINGWORTH said it was his impression that some foreign machines needed less maintenance but that they were not more efficient.

Notes from the Branches

In proposing a vote of thanks to Mr. Killingworth, Mr. Cates said that during his own foundry experience he had worked under Mr. Killingworth at Ruston & Hornsby's foundries. It was a pleasure to hear him, and renew acquaintances. The slides and photographs had offered much material for discussion and this had proved very interesting.

Mr. Cates concluded by complimenting the speaker upon the interesting material that he had collected for presentation.

West Wales Section

At a meeting of the West Wales section of the Institute of British Foundrymen held in Swansea on January 25 the following two films were shown:—(1) "Flow of Metal into Moulds" prepared by the T.S. 35 sub-committee of the Institute, and (2) "Mechanization in Coremaking" which showed some examples of coreshop equipment and methods used in a number of highly mechanized foundries in the USA. In the general discussion which followed, some members thought that the sub-committee for the first film should have been more specific in saying which type of runner they considered most satisfactory in each group, while comment on the second film was mainly about the teamwork that had been developed by the operators in these production arrangements. The president expressed the thanks of the meeting to the management of Richard Thomas & Baldwins, Limited, for the loan of the projector and the use of the room, also to the operator for his efforts.

New Catalogues

Corebinder. F. & M. Supplies, Limited, 4, Broad Street Place, London, E.C.2, have just issued a 12-page well-produced brochure covering their Supinex "R" grade of corebinder. Two main claims are made for the material—low fume-emission during casting and easy knock-out afterwards. Low fume-emission is related to a specific recommendation of the "Garrett Report" for research and development on this aspect of corebonding, and, to demonstrate the second feature, use is made of an excellent series of photographs of castings from which spent coresand is literally being poured. The brochure is available to readers from the address quoted.

Welding Equipment. A new technical circular dealing with manipulative equipment for manual and automatic arc welding has been issued by Quasi-Arc, Limited, of Bilston, Staffordshire. The pamphlet includes a number of illustrations of typical uses of the equipment to provide efficient welding. Also included are details concerning roller beds, welding positioners, cantilevers, the "radial-beam positioner," and the "internal welder." Copies of the circular (T.C. 103) are available on request from the address quoted above.

Photographic Materials. A 25-page stock list has been issued by Kodak, Limited, Kingsway, London, W.C.2, giving sizes and packings of the various photographic papers they produce.

A £250,000 ORDER for six gas turbine engines to be sent to the Middle East has been given to Ruston & Hornsby, Limited, Lincoln.

Law Cases

Uneven-floor Judgment

His Honour Judge R. H. Norris gave judgment at West Bromwich County Court recently in a case (reported in the JOURNAL, January 10) in which a shot-blaster sued his Smethwick employers for damages and negligence following an accident—caused by an uneven floor—in which he received a double rupture. The claim by Leonard Cherrington was dismissed, the Judge finding for the defendant firm, the Incandescent Heat Company, Limited, with costs.

His Honour said that but for two well-healed scars, the plaintiff was "as good a working man as he was before with no incapacity which could be attributed to the accident." In his opinion it was going too far to say that the floor of a factory over which trucks had to be run must be evenly surfaced, and he was not satisfied that the floor was so uneven that it was negligence on the part of the employers to fail to maintain the floor in a better state. Plaintiff had also alleged that defendants had failed to instruct him in the manner in which the casting should be disengaged, but the Judge thought that Cherrington knew as much about it as anybody as he had been on the job for six years.

Blame Divided in Foundry Accident

Last week the Court of Appeal allowed an appeal by Mr. Maurice Greensmith (51), of Thorncliffe Avenue, Chapeltown, near Sheffield, against the dismissal by Mr. Justice McNair at Sheffield Assizes last June of his claim for damages from his employers, Newton, Chambers & Company, Limited, Thorncliffe.

Lord Justice Denning said that on April 28, 1953, Greensmith stood with his left foot on the bracket of an electric truck in the company's foundry, and when it began to travel a skip containing castings moved and crushed his left leg. The castings were resting on the axle of a bogie and when the axle rotated the castings moved with it. It was a faulty system to have castings resting in that position and Greensmith's action in standing on the bracket was not the sole cause of the accident. His employers were also at fault and they and Greensmith were equally to blame. There would be judgment for Greensmith for £362 10s., half the assessed amount of damages.

Lord Justice Romer and Mr. Justice Lloyd-Jacob agreed.

Crushed between Stanchion and Crane Load

At a recent inquest at Brierley Hill, concerning the death of an employee of the Round Oak steelworks, the coroner, Mr. D. F. Cave, said the management was in no way negligent, but it had cost a life to discover the risk involved in moving steel slabs near stanchions. The inquest was on Joseph Mallen (39), chargehand, who was crushed by a three-ton slab of steel against a steel girder as it was being swung into position by a crane. The crane driver, Sidney Burnham, said Mallen was directing operations. He was standing between the slab and a stanchion. The metal seemed to be stuck when suddenly it swung loose and Mallen was caught. Since the accident, it was stated, notices had been posted forbidding similar operations near the stanchions. The jury returned a verdict of accidental death.

HARTLEPOOL CORPORATION has approved detailed plans for additions to the works of the Steetley Magnesite Company, Limited.

Inventions by Employees: Employers Right to Benefit

By "Barrister-at-Law"

The novel and interesting question, as to whether an employer was entitled to the benefit of an invention relating to his business which had been invented by the employee while still in his employment was considered recently in the case of British Syphon Company, Limited, *v.* Homewood. The principle involved will of course apply to all kinds of employments, industries, and inventions.

In this particular case the plaintiffs employed the defendant as their chief technician to advise them on all technical matters relating to their business and he was placed in charge of design and development. The defendant was engaged in this capacity until May 3, 1955. As from that date the defendant was employed for a further period and in a different capacity, and under terms which would have entitled him to retain for himself the benefit of anything that he invented after that date.

Relevant Facts

On September 30, 1955, the defendant ceased to be employed and he was employed by another company. During the first period of his employment and before May 3, 1955, the defendant in pursuance of his duties was engaged on behalf of his employers in evolving a certain article in connection with his employer's business. The article was duly processed, and it became the undisputed property of his employers. Thereafter no technical problem arose in connection with the invented article, and the defendant was not specifically asked to give further advice in relation thereto. In about the month of April, 1955, and accordingly while the defendant's employment as technical adviser was still subsisting, the defendant designed and invented a new appliance which was an improvement on the one referred to above and in the production of which he had been specifically engaged. It is to be noted that he had not been asked by his employers to produce the improved article, or to give any advice in relation thereto. The question thereupon arose, whether the employers were entitled to the benefit of this invention as well, in respect of which the defendant had applied for Letters Patent. The Court held that the employers were entitled to the benefit of the invention and were entitled to an order directing the defendant to assign to them his interest in the application for the Letters Patent.

The ground on which the Court arrived at this decision is not without interest. Although the defendant had had no particular problem in relation to the invention of the improved article put before him by his employers, yet it was his duty to stand by all the time during which he was employed, and to tender his advice and to assist in any problem that his employers might put to him. In the view of the Court, it would not be consistent with good faith, as between master and servant, that the latter should be in a position such as would entitle him to make some invention in relation to a matter concerning his employer's business, and either to keep it from his employer, or even to sell it to a rival.

Duty of Employee

It was the duty of the employee not to put himself in a position in which he might have personal reasons for not giving his employer the best advice which it was his duty to give, if and when asked to give it.

As the Court put it, "The employee has a duty to be free from any personal reason for not giving his employer the best possible advice. *A fortiori*, he is not entitled to put himself into the position of being able to say 'You retained me to advise you, and I will tell you what I advise. Do it this way, but you will have to buy this method from your rival because I have just sold it to him, having invented it yesterday.' That seems to be reasoning which makes it right and proper to decide that this invention, if made during a time during which the employee was standing by (for the purpose of giving technical advice under the terms of his employment), must be held to be in equity the property of the employer.

Inventions not Relating to Employer's Business

This principle, of course, would only apply to inventions by the employee relating to matters concerning the employer's business. It would not apply to inventions which had no relation thereto. In respect of such inventions the employer could not, it seems, be entitled to any benefit.

PREPARATIONS are now in hand for the second stage of the £400,000 programme for modernizing the cogging mill at the Rotherham works of Steel, Peech & Tozer branch of the United Steel Companies, Limited. The first stage has just been completed and by next autumn, the cogging mill will be handling 24,000 tons of ingots a week compared with last year's average of 18,500 tons. All the extra steel will be absorbed by the company's Brinsworth continuous medium strip mill, which is due to start up in the middle of April.

AUTHORIZATION of imports of 100,000 tons of iron and steel for arrival before the end of June this year has been announced by the Japanese Ministry of Trade, which is prepared to allocate foreign exchange reserves totalling $20,000,000 for this purpose. The total of import arrivals against past authorizations was estimated at about 200,000 tons at the end of December and is expected to reach 450,000 tons at the end of March. The Ministry has also decided to permit additional imports of 37,000 tons of electrolytic copper, scrap copper, and blister copper.

Publications Received

Nickel Bulletin, October-November.—Issued by the Mond Nickel Company, Limited, Thames House, Millbank, London, S.W.1.

Literature referred to in this recent issue of the *Nickel Bulletin* includes a comprehensive survey of nickel developments in Canada (with additional notes on world conditions in the nickel industry), new American Welding Society specifications for welding rods and electrodes for joining nickel and nickel alloys and cast iron, and an amplified edition of the atlas of isothermal transformation diagrams of B.S. En steels. A further item of particular interest in relation to construction steels is a summary of papers presented at a recent symposium on fatigue.

The section of the *Bulletin* concerned with heat- and corrosion-resisting materials contains abstracts reporting further study of the phenomenon of corrosion by vanadium pentoxide, and a review of information on atmospheric corrosion contributed to the 1955 meetings of the American Society for Testing Materials. Copies of the *Bulletin* are available free of charge from Thames House.

Occupational First Aid. Published by the St. John Ambulance Association, St. John's Gate, Clerkenwell, London, E.C.1; price 2s. 2½d. post free.

This standard textbook carries the syllabus and details of a course of six lectures on occupational first aid. A certificate is granted to those successfully passing the terminal examination. The course is much more advanced than those pursued for the granting of the First Aid and Home Nursing Certificates. The final lecture (No. 6) entitled "Strategy of a Major Accident Involving a Large Number of Casualties" is one which should be studied by those responsible for first aid in all large works, for herein is shown the vital need for preplanning and staff briefing in much the same way as the civilian services operated during the war for fire-fighting, and kindred activities. Without exception, every foundry, be it large or small, should possess and read this very cheap publication.

Hayti—Economic and Commercial Conditions, by S. Simonds, O.B.E. Published for the Board of Trade by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2; price 2s. 6d. net.

This interesting report is only of academic interest to the foundry industry. It tells of a country which would be described by the estate agents as "ripe for development." In 1948, a United Nations Mission made a report and since then have maintained a team of experts to advise in all branches of national activity. The dearth of good roads is given as a limiting factor to trade. Foundries making sugar- and coffee-plantation machinery should be interested in this market. The natural resources in minerals are, at the moment, bauxite and copper. The tourist trade is becoming increasingly important.

Iron and Steel Trades in 1956. Published by Wm. Jacks & Company, Limited, Winchester House, Old Broad Street, London, E.C.2.

This review rightly differentiates between the iron and steel trades and the foundry industry, and sticks to its text by rigorously excluding the latter. Bearing this fact in mind, this booklet, as usual, is an excellent survey of the iron and steel industry during the past year.

Book Reviews

Mechanical World Year Book 1957. Published by Emmott & Company, Limited, 31, King Street West, Manchester 3; price 4s. 6d. net.

The steam turbine for power generation is being built in increasing sizes and of greater efficiency, a trend which has been reflected in recent editions of the "Mechanical World Year Book" in the section giving particulars of these machines. Now that the atomic reactor offers a supply of energy running into thousands of years in terms of world power needs, in contrast with hundreds of years for coal and decades for oil, and since the steam turbo-generator seems settled as the means of translating the heat of nuclear fission into electrical energy, the steam turbine has an assured future for which it is well fitted by the years of scientific and technological work which have gone into its development. This section in the 1957 edition of the Year Book has been brought up-to-date as usual, and in addition has been revised in certain important technical matters relating to the latest developments. The press-work section has been revised completely for this edition as also has the section on boiler mountings; minor revision has been made in several other parts of the text.

"Death in Melting," by Richard Grayson. Published by Hammond, Hammond & Company, Limited, 87, Gower Street, London, W.C.1; price 10s. 6d. plus postage.

The dust-cover on this detective fiction story shows a foundry ladle teeming over the lip, and this might mislead purchasers into thinking that the scene of the crime was in a moulding shop. In fact the body connected with the main murder—there is more than one—was disposed of by placing it, covered by limestone, in an open-hearth charging box in a steelworks.

The book is uncommonly well written; the author has mastered steelworks practice and has dropped no "bricks"—except that it is unusual for the Iron and Steel Institute to have evening sessions—and the technique of assembling half-a-dozen suspects is cleverly accomplished. A crime novel, about an industry of which most of the readers of this JOURNAL are fairly familiar, cannot fail to appeal to them. The reviewer thoroughly enjoyed reading the book and though he has no pretensions to being a "who done it" expert, he can highly recommend it as a very pleasant means of distraction after attending "productivity meetings and discussions with shop stewards."

House Organs

Sif-Tips, Vol. 22, No. 95; published quarterly by the Suffolk Iron Foundry (1920) Limited, Stowmarket.

There is much about the welding of light alloys in this issue and particularly cast aluminium and magnesium. Previously there has been a dearth of information about both these subjects. A note included with the issue states that the company is open to receive names for adding to the mailing list.

Aero Research Technical Notes. Bulletin No. 166; issued by Aero Research, Limited, Duxford, Cambridge.

This issue is devoted to the use of "Araldite" in the woodworking industry, and though it does not specifically mention patternmaking, it does deal with related industries and thus has some interest for foundrymen.

Corrosion of Cast Iron*

The corrosion of cast iron has been well demonstrated by old cannon balls recovered from marine sites. The iron becomes covered with a porous friable mass of ferric oxide combined with water. The underlying layers of rust in time turn dark green and tend to become black. The core in turn becomes graphitized and when exposed to the air it is spontaneously heated, and in a red-hot condition will fall to pieces. This was noticed in the guns of the Armada ship, The Florida, sunk off the coast of Mull in 1588 and recovered in 1744 after 156 years under the sea. When scraped the iron became so hot that it could not be touched.

There are many recorded cases of cannon balls being graphitized and one instance on record establishes that a ball exploded when suddenly exposed to the atmosphere. In 1794, a cannon ball was recovered in Carlingford Lough in Ireland and taken ashore at Warrenpoint. A man with a heavy hammer hit a blow, the corroded shell came off like the shell of a nut, the dark core glowed red and exploded throwing the hammerman a distance of some yards. Other cannon balls were found at the same spot and were handled more carefully by scraping off the ferric coating, when they crumbled to pieces. Army experts proclaimed that these cannon balls dated from the War of the Revolution around 1690.

Preservation

The question of preserving cast iron from this form of corrosion occupied the attention of engineers and architects, and one Millar, a Belfast architect of the early decades of the last century adopted a method which proved successful. While building a church in the 1830's he made wide use of cast iron for fluted Doric columns and foundation plates. These plates are of great interest as they were buried in marine sleech and were coated with Millar's preservative. This consisted of two parts of coal tar; one part of Stockholm tar, and one part of hog's lard. To this was added one part of pitch, one of Russian tallow and two pounds of alum. The tars and lard were first boiled together and the pitch and tallow added, the mixture further boiled, adding the alum.

The foundation plates, some of which were 10-ft. long by 6-in. broad, were removed after the air raids of 1941 (when the church was destroyed); they were in an almost perfect, rustless condition, and as sound as on the day they were laid. The preservative used by Millar was intact. The fluted Grecian columns too were in a perfect condition, having been treated with the same solution.

* Reprinted from an article "Graphitization of Cast Iron" appearing in *Corrosion Prevention & Control*, December, 1956.

HARLAND ENGINEERING COMPANY, LIMITED, Alloa, have secured two orders for the manufacture and supply of their latest type of boiler-feed pump for power stations at Nijmegen and Buggenum in Holland. The value of the orders is over £165,000.

A Note on Core Prints

By "Tramp"

It was once said that the way in which a pattern-maker prints his patterns is a good indication of his grasp of foundry practice. Often patterns received by the foundry are well designed, with the exception of the printing arrangements, and as a result, the moulder has to take extra precautions to ensure trouble-free castings. A slight modification to the prints can often reduce the moulder's work and ensure sound castings.

Fig. 1 illustrates such a case. It is part of a special type of clutch casting, the joint of the mould being along line AB. The core C for lightening the boss was made as a ring. When received the pattern had prints as D and E, the latter being a complete ring.

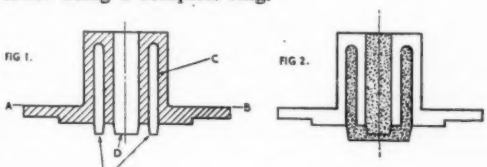


FIG. 1.—*Section of part of a clutch casting, illustrating the original method of printing, and* FIG. 2.—*Shows the modified method of printing.*

There were two objections to this method of printing. The first being the narrow ridge of sand left in the mould between prints D and E, and the second, that some means had to be adopted to hold core C in position. This could be accomplished by either wiring down through the bottom, or by means of studs on top. Each method was costly in moulder-time and carried an element of risk. By modifying the printing arrangements as Fig. 2, both objections were eliminated. The ring core being first assembled in a large print, the centre core was placed in a print in the first core and the whole kept down by the second core touching the top of the mould, a simple alteration which improved efficiency.

PRODUCTION of large power transformers by Ferranti, Limited, continued during 1956 at the high level of recent years, and 89 were despatched, including 52 to supply authorities in the home market. Included in those shipped abroad were two sets for the Aluminium Company of Canada. One set, installed in the underground power station at Kemano, British Columbia, is believed to be the largest bank with aluminium windings in the world.

Other exports contracts completed during 1956 included two banks of generator transformers for the US Army Corps of Engineers, McNary Dam project, two for the US Bureau of Reclamation and a number for South Africa, India, and New Zealand. Among large orders received was one for the Kariba hydro-electric scheme, believed to be the largest overseas transformer 'contract ever placed in Britain.

Company News

NORTON INDUSTRIES, LIMITED—A final dividend of 15 per cent. (against 12½ per cent.) brings the total payment to 20 (17½) per cent.

ENFIELD CABLES, LIMITED—Following rumours that an offer had been made for the company's ordinary stock, the directors state that they have received no such offer and are unaware that one is in contemplation.

INTERNATIONAL HARVESTER COMPANY OF GREAT BRITAIN, LIMITED—Sales for the year ended October 31, 1956, fell by 10 per cent. to £11,383,443 (from £12,635,379 for 1954-55), due to the general economic situation.

UNITED STATES STEEL CORPORATION—The company has declared a quarterly dividend of 75 cents a share on the common stock, against 65 cents previously. Net profit for the year 1956 was $347,900,000 ($370,100,000), or $6·01 ($6·44) a common share.

BENZOLE PRODUCERS, LIMITED (formerly National Benzole Holdings, Limited)—The company plans to redeem the 1,000,000 6 per cent. preference £1 shares on March 1 at 23s. a share and to pay the accrued dividend for the period January 1 to March 1 inclusive.

B. ELLIOTT & COMPANY, LIMITED, machine-tool manufacturers, of London, N.W.10—An interim dividend of 7½ per cent. on doubled capital is announced. The board states that this does not indicate an increased total for the year. The corresponding equivalent interim was 6½ per cent.

ANTI-ATTRITION METAL COMPANY, LIMITED—A centenary bonus of 1 per cent. is being added to a maintained dividend of 7½ per cent. on the £400,000 one-class capital, for the year ended July 31, 1956. Profits rose from £54,162 to £82,108 before a tax provision which rose from £25,000 to £39,250.

MILES DRUCE & COMPANY, LIMITED, iron and steel stockholders, of London, W.3—The offer made by the company to acquire the whole of the ordinary share capital of Godwin, Warren & Company, Limited, has been accepted by the holders of over 97 per cent. of the total issued ordinary stock of Godwin, Warren.

INDIAN IRON & STEEL COMPANY, LIMITED—The company has announced the offer of 5,183,708 new Rs. 10 ordinary shares to holders registered on March 11 on a one-for-one basis. The World Bank signed an agreement with the company in December giving it a loan of $20,000,000 to finance its expansion programme.

ASSOCIATED COMMERCIAL VEHICLES, LIMITED—The directors announce that underwriting is now in progress in connection with the issue of 5¾ per cent. unsecured loan stock, 1977-82, which the company is offering at 97 per cent. to its preference shareholders and ordinary stockholders on the register at the close of business on February 1.

NEGRETTI & ZAMBRA, LIMITED, scientific instrument manufacturers, of London, W.1—The board is raising the dividend on the £350,000 ordinary capital by 2 per cent. to 15 per cent., less tax, with a final of 11 per cent., against 10 per cent. Net profit for the year to September 30, 1956, has expanded from £217,552 to £260,260, subject to taxation of £131,405 (£106,720).

MARCROFT WAGONS, LIMITED—Following the appeal by the company against the income tax assessment referred to in the circular letter last May, the directors report that the assessment has been discharged. The consent of the CIC to the proposed issue by the company of 100,000 ordinary shares of £1 each as capitalization of reserves has been extended to June 28.

BROOM & WADE, LIMITED, manufacturers of compression equipment, etc., of High Wycombe (Bucks)—Delivery dates have improved with increased output and for the first time for many years it has been possible to allocate part of output for stocking overseas agents and subsidiaries. Consolidated profits rose by 12 per cent. to £623,658, and the dividend is 12½ (10) per cent.

PULSOMETER ENGINEERING COMPANY, LIMITED—Philip Hill, Higginson & Company, bankers, announces that it has acquired the Camp Bird group's interest in Pulsometer Engineering. As a result, Mr. John Dalgleish, chairman of Camp Bird, has resigned from the Pulsometer Engineering board. Information published last June, when the £560,000 ordinary capital of Pulsometer Engineering was marketed, Camp Bird held just over 50 per cent. of the equity.

CLEVELAND BRIDGE & ENGINEERING COMPANY, LIMITED—Mr. J. R. Dixon, the chairman, states in his report for 1955-56 that the company's order-book is such that the company can look forward to a busy three years' programme of work. The value of contracts taken up during the year was approximately £3,000,000. The chief difficulty in the works, says Mr. Dixon, is the unsatisfactory steel position which largely controls output. The board is having discussions with its advisers concerning future financial arrangements.

ENGLISH CHINA CLAYS, LIMITED—Group profits, before tax, are down by about £90,000 to £2,158,197, but much of this is offset by lower taxation, the balance being £1,222,197 (£1,247,169). The final dividend of 3½ per cent., tax free, makes 5½ per cent., tax free, for the year to September 30, 1956, on £4,819,982 ordinary capital, an effective increase of ½ per cent. over the previous equivalent. The dividends are on the capital as increased by a 100 per cent. free scrip issue and issues against acquisitions. Cost of preference dividends is increased following the reorganization by which English Clays Lovering Pochin & Company, Limited, became a wholly-owned subsidiary.

QUALCAST, LIMITED—Reporting on trading for the half-year to December 16, 1956, Mr. Victor Jobson, the chairman, says that the turnover shows a considerable cutback. In all the circumstances, results are not unsatisfactory, although not up to the corresponding 1955 period. However, he adds, the second part of the group's trading year "is always our best earner" as this is the time when lawn mowers are sold in the home market. Last October, in his statement with the 1955-56 accounts, Mr. Jobson expressed the opinion that foundries would all be working to capacity again by the end of the year, but they are largely interested in the motor and refrigerator trades and where calculations are based on the viewpoint of customers these have not developed to the extent anticipated, he says.

Recent Wills

CHAMBERS, C. R., chairman and managing director of Gaskell & Chambers, Limited, engineers, brassfounders, etc., of Birmingham £30,442

GRAY, BASIL, late director of the English Steel Corporation, Limited, Sheffield, who, during the war, as superintendent of the Grimesthorpe Works, was responsible for the production of large quantities of armour castings and the "Grand Slam" bombs £89,855

STEEL, J. E., chairman and managing director of Steel & Company, Limited, engineers, etc., of Sunderland (he controlled 10 subsidiary companies in the UK and three oversea), a director of the Burntisland Shipbuilding Company, Limited, and chairman of the North Regional Council of the Federation of British Industries £48,592

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

764,015. Enn Vallak, 19, Avenue Beau Séjour, Geneva, Switzerland.

A chill mould for casting metals. It consists of two separate sections; a base forming the bottom of the mould, and carrying the sections. Each section has a hollow cooling jacket with an inlet and an outlet for cooling medium together with means for keeping the sections closed during the pouring of the metal in the moulds. Means are also provided for separating the sections, after solidification, of the metal. The base is carried on wheels or the like, and is separable from the sections in order to allow removal of the bottom part together with the casting from the two sections.

764,157. F. J. O. Hurum, Dronningensgt, 50, Trondheim, Norway.

A method of reacting magnesium with a molten metal or alloy at a temperature above the boiling point of magnesium. Magnesium in its metallic state (or as an intermetallic compound, or as part of an alloy) is embedded in a briquette provided with a hole. This is kept forcibly submerged by threading it on to a rod or stake. The briquette itself consists mainly of burnt lime and/or dolomite (see also Patent No. 716,856).

764,170. J. Pluhar, 12 Nad Dionyskou, Praha-Dejvice, Czechoslovakia, and M. Vyklicky, 121 Jeseniova, Praha-Zizkov, Czechoslovakia.

A refractory weldable cast iron/aluminium alloy. It contains aluminium 28 to 32, carbon 0.9 to 1.3, phosphorus less than 0.4, and silicon less than 0.5 per cent., the balance apart from usual impurities being iron.

764,193. Ilario Properzi, Via Cosimo del Fante, 10, Milan, Italy.

A machine for the continuous casting of metal rods from molten metal, and reference is made to such machines of the type utilizing a rotatable casting drum having a groove formed in its periphery by an endless belt to form a casting mould (see also Patent No. 660,692).

764,202. A. B. Westin and Backlund, 8 Liljeholmsvagen, Stockholm, 9, Sweden.

New and useful improvements in moulding machines of the kind in which a patternplate, mould board (or the like for supporting a flask) is adapted to be pushed forward by engagement with successive patternplate, or mould board, so as to be conveyed through a jolting apparatus to the next operating station, or stations, of the machine.

764,213. Societe d'Electro-Chimie d'Electro-Metallurgie et des Acieries Electriques d'Ugine, 10, Rue du General Foy, Paris, Seine, France.

The desiliconizing and desulphurizing of pig-iron, by heating with oxidizing agents (for the silicon) and with lime or magnesium, and metal oxides, with, if necessary, fluorspar (for the sulphur). (See also Patent No. 742,202, FOUNDRY TRADE JOURNAL, January 19, 1956.)

764,285. US Atomic Energy Commission, Washington, D.C., USA.

Zirconium-base alloys containing tin which have a high tensile strength at elevated temperatures, a high degree of ductility and good corrosion-resistance.

764,533. Distillers Company Limited, 12 Torpichen Street, Edinburgh, 3, Scotland.

Improvements in the shell-moulding process, with particular reference to the lubricants used for treating the moulding surface of the metal patterns (reference should also be made to F.I.A.T. report no. 1,168, and to G.P. No. 832,937, and Patent No. 674,421). A heated metal-pattern is put into contact with a mould mixture, comprised of a finely-divided granular material mixed with a thermosetting resin. Wax, such as Montan wax, is applied to the moulding surface of the heated pattern. This wax is applied as an aqueous emulsion before the moulding mixture is applied.

764,536. Gebr. Bohler & Company, A.G., 14, Elisabethstrasse, Vienna, 1, Austria.

Process of continuous casting especially for metals of high-melting point. A material having the same composition (or different composition from the molten metal, or even fluxes) is added to the molten metal in the mould. The mixing of the added material with the molten metal is effected by means of a magnetic or electro-dynamic field.

764,548. Société D'Inventions Aéronautiques et Mécaniques, S.I.A.M., 1 Route des Alpes, Fribourg, Switzerland.

Magnesium-base alloys of the group comprising magnesium zinc, and cerium in the form of mischmetall. It has the following composition, zinc 6 to 7, aluminium 0.4 to 0.6, beryllium 0.08 to 0.012, mischmetall 0.5 to 1.5, silicon up to 0.15 per cent. No manganese is present and the balance, apart from impurities, is magnesium. The composition of the mischmetall is as follows, cerium 47 to 50, lanthanum 25 to 27, neodymium 15 to 17, praseodymium, samarium and yttric earths together 8 to 10, iron 0.2 to 0.5 and silicon up to 0.15 per cent.

764,712. E. Buehrer, 117, Alpenstrasse, Schauffhausen, Switzerland.

Moulding machines for producing foundry moulds by squeezing, or simultaneous inertia-jolting and squeezing operations in order to compact the granular material employed in the production of the moulds. In the inertia-jolting process, the motion of the granular material for instance in free fall is suddenly checked. It is known that this checking causes a force of inertia within the granular material itself, which in contrast to the squeezing process causes the granular material to be more tightly compacted in those layers of the mould closest to the patternplate. An additional squeezing effect can be obtained by placing a weighting plate on the granular material during the inertia-jolting process.

A moulding table is adapted to carry a patternplate and moulding boxes. It also carries a squeezing press having rigid members firmly connected to it. These are provided with faces for engagement during a squeezing operation, or during a simultaneous inertia-jolting and squeezing operation. On the moulding table, or on parts which are firmly connected to the moulding table, there are counter faces arranged in such a way that members can be disengaged, following the operation to form relative displacement of the press and moulding table.

764,716. Polygram Casting Company Limited, Power Road, Gunnersbury, London, W.4.

Apparatus for the manufacture of moulds, or hollow cores by the shell-moulding process. In the process, physical movement (such as inversion) of the pattern takes place during the formation of the mould core, etc., which is later separated from the pattern by means of ejector pins. One of the principal objects of the invention is the prevention of the movement of the pattern during the inversion.

"Hot" Cooling of Tuyeres

Blast-furnace Development which May Extend to Foundry Furnaces.

The technique known as "hot" cooling has already made considerable strides in the German steel industry and it is considered may be capable of application to water-cooled cupolas and electric-arc furnaces in foundry practice. It consists essentially of using the hot spots in an iron and steelworks as generators of steam by feeding in cooling water at a reduced rate. Instead of the water leaving the cooler at some temperature below 100 deg. C., the contents of the cooler are allowed to reach 100 deg. C., at which temperature some of the water boils. The entire element is kept at this temperature and the cooling is effected not simply by the specific heat of liquid water but also by the latent heat required to turn some of this water into steam.

The cooling of the refractory lining of converter chimneys is now well-established on the Continent, since the intensely hot converter flame resulting from the use of oxygen enrichment makes this necessary. Hot cooling has been introduced, for this purpose, particularly for the operation of L-D plants, and as a result part of the heat normally lost from the converter can be usefully recovered.

Scope of Experimental Work

The main reason why hot cooling has been adopted has been the shortage of cooling water from which certain German steelworks have suffered in recent years. At first, the experiments were confined to the hot cooling of a single blast-furnace tuyere only, and then a plant was built to deal with three tuyeres. An experiment has now been started in which one complete blast furnace will use the hot-cooling system for all the tuyeres. The ironmaking capacity at Sulzbach is being expanded—the present six furnaces ranging in volume from 300 to 510 cub. m. (approximately 10,000 to 18,000 cub. ft.) are to be rebuilt to an internal volume of 600 cub. m. (21,000 cub. ft.) and a hearth diameter of about 6 m. (20 ft.). The hot cooling experiment now in progress is being conducted on a small furnace with a hearth diameter of 4.3 m. (14 ft.).

The general arrangement of a hot-cooling-water circulating system for a blast-furnace tuyere is illustrated in Fig. 1. The triple outlet from the tuyere is made up of three pipes each with a diameter equal to that of the inlet pipe. The outgoing stream of hot water and steam rises a distance of 6 m. (20 ft.) before entering the header tank. This is equipped with a gauge glass, a safety valve and a make-up water inlet with a regulator in the manner shown. In order to be able to examine the cooling operation a sighting glass has been let into the rising outlet pipe. Arrangements have been made in the experimental system so that the normal system of cooling may be reverted to at any time required.

At first the pressure in the system was maintained at 0.5 atmospheres. Under these conditions, however, a free water circulation was not achieved and the tuyere began to bump. On raising the pressure to 1 atmosphere an improvement in circulation and smoother operation was obtained and the pressure was therefore progressively increased to 2 to 5 atmospheres. With increase in pressure the circulation of water improved.

The saving of cooling water by using hot cooling is considerable. For each tuyere 70 to 100 litres of water per hour are circulated, which carry away from 45,000 to 60,000 kilocalories of heat per hr. Formerly, to effect the same degree of cooling, with water rising in temperature from 10 deg. C. to 13 deg. C., required some 100 litres of water per min. The amount of water needed for hot cooling is then only 1/60th of that consumed formerly. As make-up water for hot-cooling, soft boiler-feed water at a pressure of 5 atmospheres is used.

Further advantages which may accompany the use of hot cooling are, that a closer watch can be kept on the behaviour of the tuyeres. Any leakage for example can be immediately detected as it will give audible warning, and the consumption of make-up water will at once start to increase. From the appearance of the water rising in the offtakes, seen through the water-glasses, the incorrectly operating tuyere can be detected immediately.

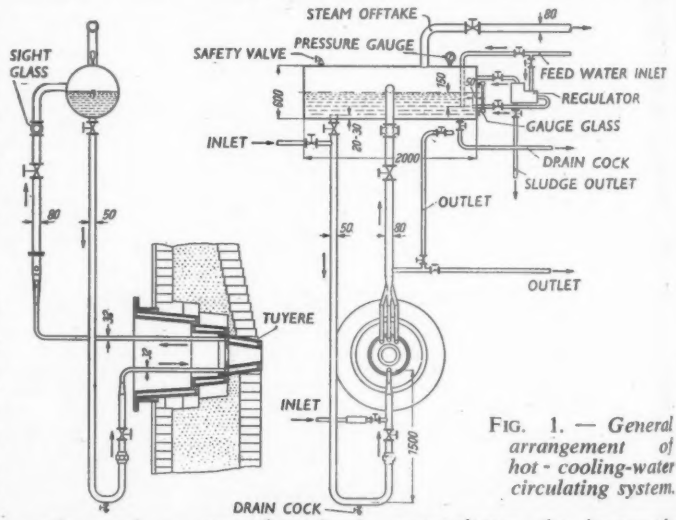


FIG. 1. — *General arrangement of hot-cooling-water circulating system.*

News in Brief

THE Vienna International Spring Trade Fair is to be held from March 10 to 17.

THE UNITED STEEL COMPANIES, LIMITED, has installed a Siemens II electron microscope in their central research and development department.

LATEST STATISTICS, for the four weeks to January 27, issued by the British Transport Commission reveal an increase of 22 per cent. in British Railways passenger takings and an 11 per cent. increase in rail freight receipts. The increases reflect the effect of the diversion of traffic from road to railway brought about by the fuel situation.

Mr. G. P. TINKER, managing director of Birlec, Limited, Birmingham, who has returned from a month's business visit to India and Pakistan, has announced that his firm has orders worth more than £500,000 from this area on hand. He said that the company had done more than £1,000,000 worth of business there in the past 10 years.

ROLLS-ROYCE, LIMITED, is to move its diesel-engine division from Derby to the Sentinel works at Shrewsbury which it acquired from Metal Industries, Limited, last year. The move to the Sentinel works (which has 500,000 sq. ft. of floor space compared with 200,000 sq. ft. at the Derby works) will take place over a prolonged period to avoid dislocating production.

Mr. FRANK SOMERS, the well-known industrialist associated with Walter Somers, Limited, Halesowen, is to be honoured by the conferment on him of the honorary Freemanship of Halesowen. He will be one of the first two honorary Freemen receiving the award as part of the Halesowen 21st anniversary celebrations of its receiving its Borough Charter. Mr. Somers is 74.

AN ELECTRO-MAGNET, claimed to be the largest of its kind, constructed entirely of steel castings, has recently been installed in University College, London, by Edgar Allen & Company, Limited, Sheffield. The firm's research and foundry departments co-operated closely with the Physics Department of the College, in this project, and about 25 tons of steel castings were used.

CARBIDE INDUSTRIES LIMITED, a subsidiary of the British Oxygen Company, Limited, has arranged to purchase a site of 50-acres near Londonderry, Northern Ireland. Assuming satisfactory arrangements for the acquisition of facilities and supplies, Carbide Industries Limited, plan to produce acetylene primarily for supply to the du Pont Company (United Kingdom) Limited, for the manufacture of neoprene.

CO-ORDINATION of distribution of special messages which will be sent to leading scientists, research stations, observatories, etc., in connection with the International Geophysical Year is being arranged by the GPO in conjunction with the Department of Scientific and Industrial Research. Worldwide research into the various phenomena associated with the earth and its planetary system is being conducted by 45 nations in 1957-58.

A NEW MERCURY VAPOUR LAMP, of 4,750 w., made by Hackbridge & Hewittic Electrical Company, Limited, of Walton-on-Thames, will be seen in action for the first time at the Electrical Engineers Exhibition, (Earls Court from April 9 to 13). The lamp weighs between 60 and 70 lb. is 50-in. long and is 8-in. dia. It will be suspended at a height of 100 ft. and will provide an overall light for the 330,000 sq. ft. covered by the exhibition.

THE French light iron castings association have established at the *Centre Technique des Industries de la Fonderie*, a new department for the testing and approving of gas-fired domestic apparatus. Those satisfying the conditions will be accorded the quality mark, "N.F.—Gaz." The testing and approving of solid-fuel-fired apparatus has long been undertaken at the *Centre* and the quality mark accorded for this type is now recognized as the standard in France.

MILITARY VEHICLES of the west German Army are to be powered by B. 81 Rolls-Royce petrol engines. A contract, worth initially £8,500,000, the terms of which include the supply of spares, training of key men on maintenance and overhaul, and advice on layout of equipment, has been signed in Bonn. The engines will be fitted in tracked vehicles to be known as *Schutzenpanzerwagen* designed by Prince André Poniatowski in conjunction with the Hispano-Suiza Company.

VICKERS-ARMSTRONGS (ENGINEERS), LIMITED, announce that South Wales Argus, Limited, Newport, have, through their consultants A. J. Ramsay & Partners, placed an order for a three-unit Scott Vickers extra-high-speed rotary newspaper press. The press will be manufactured at Vickers-Armstrongs (Engineers) Limited, Elswick Works, Newcastle, the reel systems and tension devices are to be supplied by Witton-James, Limited, and the Fuller Electrical & Manufacturing Company, Limited, will supply the main drive and control equipment.

BROOK MOTORS, LIMITED, has organized its own unit (operated in conjunction with the company's publicity and photographic departments) for making 16 mm. films. The first production is a 20-minute black-and-white sound film, "Winding Journey," which covers the methods of work handling at the Barnsley factory. An older motor-winding department is contrasted with the electronically-controlled conveyor system in the newer factory. Copies of the film are available on free loan from the publicity department at the Empress Works, Huddersfield.

BIRMINGHAM EXCHANGE AND ENGINEERING CENTRE has recently carried out a survey among its members on the subject of participation in overseas trade fairs. A favourable response was received from most manufacturers with products suitable for export markets. The Centre is to be represented at three European Fairs this year. They are Leipzig from March 3-14; Hanover, April 28-May 7; and Vienna, Sept. 8-15. The Birmingham Centre may also play some part in the British section of the Brussels exhibition which is being organized by the Federation of British Industries.

IN 1855 two young men, Peter Currie and Charles Warner, left their jobs in a merchants' warehouse and set up a brassfounding business. Their former master sent them their first orders. On February 8, Currie and Warner of Powell Street, Summer Hill Road, Birmingham, held a centenary dinner attended by 140 employees and their families. "We are two years late" said Mr. Henry Carter Moore grandson of one of the founders "but the factory was being rebuilt when the centenary occurred." Long service presentations were made to Mr. John Williams (33 years service) and Mr. George Poole (32).

T. H. & J. DANIELS LIMITED, of Stroud, Gloucestershire, announce that they have acquired the whole of the issued share capital of British Boiler Accessories

News in Brief

Limited, the manufacturers of steam storage plant, water dejectors and other boiler equipment. The products of this company will be complementary to those of Prat-Daniel (Stanmore) Limited, who are also a subsidiary of T. H. & J. Daniels Limited, and who specialize in grit- and dust-collection plant and fume-extraction equipment. British Boiler Accessories Limited, will continue to be closely associated with Schiff & Stern Limied, who sell similar equipment on the Continent.

A SYMPOSIUM on "Aluminium in Electrical Engineering" has been arranged by the Aluminium Development Association for Thursday and Friday, May 16 and 17, at the Institution of Electrical Engineers, Savoy Place, London, W.C.2, by courtesy of the Council of the Institution. Twelve papers by electrical engineers with experience in using aluminium will be presented in the course of three sessions under the following titles—"General and Economic Considerations in Using Aluminium in Electrical Engineering"; "Aluminium in Transmission and Distribution Lines" and "Aluminium in Electrical Equipment." Full details are available from the Association, at 33, Grosvenor Street, London, W.1.

AT THE ANNUAL DINNER, on February 9, of the Birmingham section of the Institution of Production Engineers, Sir Herbert Manzoni, chief engineer and surveyor of Birmingham referred to Britain's "desperate shortage of young engineers." He said that in 1955 Russia turned out 65,000 technically trained professional men while Britain produced 5,000. Related to population Russia was turning out four to our one. Sir Herbert was proposing the toast to the Institution, and replying Mr. E. W. Hancock, president, said that the youth of Britain was just as good as ever it was. It was up to the older people to see that the Government really put first things first and to see that the country had proper colleges and universities to provide the training needed.

PRESIDING at the annual general meeting at Dudley on January 28 of Fletcher Houston & Company (founders of high-duty alloy and grey-iron castings), the deputy chairman, Mr. F. G. Thornton, reported a widening of the scope of activities for the firm. In spite of recession during the last quarter of the year it had been possible to maintain a level of output comparable to that of the previous year, due to the great variety of work produced by the foundry and forge. "No one can view the present position with any sense of satisfaction from a business point of view," shareholders were told; nevertheless, the company was expanding its activities in the hope that the adverse circumstances now developing could be met with the maximum confidence.

THE FEDERATION OF BRITISH INDUSTRIES, the National Union of Manufacturers, the Birmingham Chamber of Commerce, and the Traders' Road Transport Association will be among those organizations taking part in a conference to be held in Birmingham this month, to consider setting up an emergency clearing house to pool road-transport and save petrol. At the meeting on January 28 of the Birmingham Chamber of Commerce Council, Mr. C. E. Jordan, chairman of the transport committee of the Chamber, said that several factors were preventing the transfer of industrial traffic to the railways. Some firms had reported that rail consignments took 12 to 17 days to reach their destinations and another limiting factor was the high freightage charges. One firm found the railway quotation 450 per cent. greater than the cost of road haulage.

Political Threat a Handicap to Steel Development?

Resolutions approving the increase in the authorized capital of Stewarts and Lloyds, Limited, by 10,000,000 ordinary £1 shares and the capitalization of reserves to that amount were duly approved at last month's extraordinary general meeting.

Earlier, at the general meeting, Mr. A. G. Stewart, the chairman, said that this proposal was the natural consequence of the policy of ploughing back profits. They were certain that the policy of ploughing back profits was correct and that with the large capital expenditure programme before them it was desirable to continue to provide a large proportion of their capital from their own resources. It would not be prudent to rely on always being able to raise new capital just when they needed it.

Shareholders from time to time had expressed anxieties about the political risks involved in investing in the steel industry, said Mr. Stewart, but in his view a strong Iron and Steel Board, acting in co-operation with the British Iron and Steel Federation, provided sufficient general supervision of the industry, and any action that would throw it back into the melting pot of party politics could only have the effect of holding up development and damping initiative. Not only did the threat increase the cost of raising new capital, it was also a serious handicap to the industry in its commercial and technical arrangements all over the world.

Aachen Foundry Colloquium, 1957

The 17th Foundry colloquium organized by the Giesserei-Instituts of the Rheinisch-Westfälischen Technical High School, is to be held in Aachen on March 8 and 9. The first session opens at 9 a.m. when Dr. Tung-Ping Yao is to read a paper on "Viscosity in Binary-alloy Systems." Other lectures given in this session are: "Eutectic Crystallization," by Dr. Scheil; "Crystallization of Iron/carbon Alloys," by Professor Czikel; "Problem of the Reduction of Silica by Carbon in Melting and Refining of Cast Iron," by Professor Willy Oelsen; and the "Toughness of Grey Cast Iron," by Professor W. Patterson.

The afternoon session, starting at 3.30 p.m., is to be addressed by Professor H. Jungbluth; he will deal with the "Testing of Moulding Sand." Mr. Dietmar Boenisch is to lecture on the "Influence of Labour and Preparation Cost on the Ultimate Cost of Moulding Sand."

At the Saturday-morning session, commencing at 9.30, there are to be papers from Professor Herman Schenck on the "Making of High-quality Steels"; and from Professor Anton Koniger on the "Freedom from Inclusions in Cast Alloys, with Special Reference to Cast Iron."

Readers desiring to attend this colloquium should write to Dr. W. Patterson at the Giesserei-Instituts, 5, Intzestrasse, Westbahnhof, Aachen, Germany.

Electric Hoists. A new brochure relating to Lo-Hed electric hoists has been published by Taylor Stoker Company, Limited, 189, Drummond Street, Euston, London, N.W.1. The brochure illustrates the various types of hoists available and tabulates the dimensions of the equipment with the capacities and sizes available.

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Raw Material Markets

Iron and Steel

Some sections of the foundry industry continue to show much better results than others. High-duty castings from the engineering and speciality foundries are in good demand. Regular supplies of pig-iron in the hematite and low-phosphorus grades are being taken up, and although demands for these grades are not now so heavy from the foundries supplying to the motor-car industry, producers are able to dispose of most of their outputs without difficulty. Stocks at the furnaces and the foundries are not large, and some producers would, in fact, prefer to have some reserve to ease their delivery programme. In addition to the requirements of the foundries, large quantities of hematite are utilized by the steelworks.

Increased production of high-phosphorus pig-iron in January by the temporary changing over of furnaces from the basic steelmaking pig-iron to the foundry grade has enabled many arrears of orders to be wiped off and users are now well supplied. Demands generally show no change; until orders for light castings increase current outputs will be adequate. The light foundries are employed at varying degrees of activity, but most of them are in need of more work, as also are the textile foundries. The jobbing foundries are fairly well employed. So far as export business is concerned, inquiries for pig-iron are plentiful, but the tonnages which can be shipped will depend on the issue of licences. Outputs of all grades at present are mainly taken up by home users.

Sufficient tonnages of scrap are forthcoming, the better and heavier grades of cast-iron scrap are absorbed, but the lighter grades are more difficult to place. Foundry coke is coming forward to meet requirements, although most of the Welsh grades are scarce. Ganister, limestone, and firebricks are freely available.

The re-rollers continue to be well employed and have sufficient orders on hand to enable them to return good outputs. Home business for light sections has fallen slightly, but for small bars, particularly for reinforcing work there continues to be a heavy demand. Inquiries from overseas customers are circulating, but for this more remunerative business export licences now have to be obtained. Some of the re-rollers are running short of billets in ordinary mild-steel qualities and sizes. Tonnages from home steelworks have not made good the reduced supplies from abroad, and stocks have dwindled. There is also increased demand for small billets and carbons and special quality steels.

Non-ferrous Metals

The cut in the Bank rate to 5 per cent. last Thursday caused a mild rally in copper attributed largely to bear covering. The movement lacked any follow through, petered out on Friday, and prices have since resumed their downward course. How low the quotation will go is, of course, a leading question, and the short answer is probably not far below £240 a ton. This assumption is predicated on the belief that at 30 cents a pound (equivalent to £240 a ton) US producers, working as they are low-grade ore averaging around 1 per cent., cannot operate with a reasonable margin of profit; particularly, as seems likely, that at this price output would have to be considerably curtailed. If this is so, markets on both sides of the Atlantic are nearing their grounding points. In the States the custom smelters have lowered their price a further cent to 33 cents. The producers are holding at 34 cents, the export price has come back to a split 31¼-31½ cents a pound, and the price of No. 2 scrap is fractionally below 25¼ cents a pound. Dealers are asking approximately 32 cents, but they have only small amounts to offer. Trading activity remains at a low ebb, although export business is fair.

In Rhodesia two points are worth noting. One is the overwhelming support given by the African mine-workers for a strike. The other is the statement by Sir Roy Welensky, who has gone on record as saying that the Rhodesian Federation could look forward to a relatively stable price for copper in the coming years. He thought that if the price did fall to £240 a ton it would not fall much below that level.

Tin is a better market in New York than in London. This is because of the dock labour dispute. Apprehension of a big shipping tie-up led to demand for spot metal, which is over $1.03 cents a pound. In London the price has declined, largely in anticipation of the supply position becoming easier following the closing down of the Texas smelter. Nevertheless, consumer demand remains good on both sides of the Atlantic, the strike at the Butterworth smelter continues, and stocks are low. It is thus somewhat strange that the backwardation has narrowed to around £15 a ton. However, this may be due to sudden offerings of cash metal.

Lead is moderately active on both sides of the Atlantic, with overall demand falling below recent levels. The US stockpiling activities still dominate the markets and the US price is steady at 16 cents a pound. Zinc is an easier market in London on freer offerings from the Continent and the backwardation has closed somewhat. In America demand is only moderate and it is understood that the US stockpile did not take up all the metal offered in January. The price remains steady at 13½ cents a pound for "Prime Western" grade, East St. Louis.

New Import Certificate

The Board of Trade has made the Control of Goods (Import Certificate) (Amendment) Order, 1957 (SI 1957, No. 142), amending the form of import certificate which is required in connection with the international control over the movement of strategic goods. There are two main changes. Provision is made for cases in which the intention of the applicant is to send the goods direct to a third country under a Board of Trade licence, and for the certificate to specify the period during which it must be presented to the authorities of the exporting country. Countries within the control scheme, before licensing the export of strategic goods, may require the production of an import certificate as a safeguard against their diversion to prohibited destinations while in transit.

Associated Automation's Agreement

Exclusive manufacturing and selling rights in all sterling area countries for products to the designs of F. R. Sauter AG, of Basle, have been secured under a long-term agreement by Associated Automation, Limited. To operate the licence, Associated Automation has acquired as a wholly-owned subsidiary Sauter Controls, Limited.

F. R. Sauter AG is a leading Swiss company in precision automation and specializes in the fields of heating, ventilation, air conditioning, and also in the manufacture of oil-burner controls, solenoid-operated valves, and modulating controls. Mr. G. Steiner, of the Swiss company, is to join the board of Associated Automation.

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

February 13, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £20 1s. 0d.; Birmingham, £19 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £21 18s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £22 2s. 3d.

Scotch Iron.—No. 3 foundry, £23 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £24 6s. 6d.; South Zone, £24 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 14s. 0d.; South Zone, £25 16s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £22 17s. 6d.; Scotland (Scotch iron), Zone S. 1, £23 4s. 0d.; Sheffield, £24 4s. 6d.; Birmingham, £24 12s. 0d.; Wales (Welsh iron), £22 17s. 6d.

Basic Pig-Iron.—£19 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £51 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £75 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent.. carbon-free, 12s. 3d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £250 0s. 0d.; 38/40 per cent., £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 14s. 0d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 17s. 0d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £96 0s.0d. to £96 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. to 31s. 0d. per unit; over 6 per cent. C, £94 0s. 0d. to £95 10s. 0d., basis 60 per cent. Cr, scale 31s. 0d. per unit; 2 per cent. C,* 2s. 1½d. per lb. Cr; 1 per cent. C,* 2s. 2d. per lb. Cr; 0.15 per cent. C,* 2s. 2½d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 6d. to 23s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £75 0s. 32d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £30 9s. 0d.; tested, 0.08 to 0.25 per cent. C, £31 9s. 0d.; hard (0.41 to 0.60 per cent. C), £32 10s. 6d.; silico-manganese, £41 0s. 0d.; free-cutting, £34 13s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £38 4s. 6d.; silico-manganese, £41 7s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £36 3s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £37 6s. 0d.; acid, up to 0.25 per cent. C, £40 7s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £39 2s. 0d.; boiler plates (N.-E. Coast), £41 12s. 0d.; floor plates (N.-E. Coast), £40 11s. 0d.; sectional material, N.-E. Coast, £37 11s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £37 18s. 0d.; flats, 5 in. wide and under (4-ton lots), £37 18s. 0d.; hoop and strip, £37 17s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £41 6s. 0d.; black sheets (hand mill), 17/20 g., £52 4s. 6d.; galvanized corrugated sheets, 24 g., £65 9s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £64 13s. 9d.; nickel-chrome, £88 15s. 3d.; nickel-chrome-molybdenum, £100 13s. 9d.

NON-FERROUS METALS

Copper.—Cash, £245 10s. 0d. to £245 15s. 0d.; three months, £244 0s. 0d. to £244 10s. 0d.; settlement, £245 15s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 4½d. per lb.; rods, 279s. 6d. per cwt. basis; 20 s.w.g., 312s. 9d. per cwt.

Tin.—Cash, £766 0s. 0d. to £768 0s. 0d.; three months, £749 0s. 0d. to £750 0s. 0d.; settlement, £768 0s. 0d.

Lead (Refined Pig).—First half February, £112 15s. 0d. to £113 0s. 0d.; first half May, £112 5s. 0d. to £112 10s. 0d.

Zinc.—First half February, £99 5s. 0d. to £99 10s. 0d.; first half May, £96 10s. 0d. to £96 15s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £132 10s. 0d.; rolled zinc (boiler plates), all English destinations, £130 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £110.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 0½d. per lb.; rods, drawn, 2s. 11⅝d.; sheets to 10 w.g., 215s. 6d. per cwt.; wire, 2s. 9½d.; rolled metal, 215s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £187; B6 (85/15), —; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £238; HTB2 (38 tons), —; HTB3 (48 tons), —.

Gunmetal.—BS1400, LG2 (85/5/5/5), £257; LG3 (86/7/5/2), £268; G1 (88/10/2/½), £319; (88/10/2/1), £310.

Phosphor Bronze.—BS1400, PB1 (AID released), — per ton.

Phosphor Bronze Strip, etc.—Strip, 301s. 0d. per cwt.; sheets to 10 w.g., 301s. 0d. per cwt.; wire, 4s. 0½d. per lb.; rods, 3s. 5d.; tubes, 3s. 4½d.; chill cast bars: solids 3s. 4½d., cored 3s. 5½d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide x 0.056, 3s. 10¾d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 3½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 2½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £84 10s. 0d. to £84 15s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.: aluminium bronze (BS1400), AB1, £280; AB2, £287. Solder, brazing, BS1945. type 1 (50/50), — per lb., type 9 (54/46), — per lb.

* Average 68-70 per cent.

PATTERN LETTERS AND FIGURES

WHITE METAL · BRASS ALUMINIUM

A MILLION LETTERS IN STOCK!

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PHILLIPS LTD
POMEROY ST., NEW CROSS
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PIG IRON

Low Phosphorus
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Birmingham, 2.
39, Corporation Street.
MIDLAND 3375/6.

Liverpool, 2.
13, Rumford Street.
CENTRAL: 1558

Glasgow, C.2.
93, Hope Street.
CENTRAL: 9969.

Personal

Mr. CHARLES T. ALDERSON has been appointed a director of Ruston & Hornsby, Limited.

Mr. HUGH R. BYERS, special director and sales manager, has been appointed a director of Wm. Beardmore & Company, Limited, Glasgow.

Capt. R. P. MINCHIN, general manager of Harry Ferguson Research, Limited, tractor and implement manufacturers, of Coventry, is retiring after five years' service with the company.

Mr. N. G. BASSETT SMITH was installed the new chairman of the Institute of British Carriage and Automobile Manufacturers at the annual dinner of the Institute in Birmingham on February 7.

Ald. A. G. B. OWEN, head of the Rubery Owen organization, has been appointed chairman of the Council of the University College of North Staffordshire. He is also chairman of Staffordshire County Council.

Mr. MICHAEL PARKINSON has been appointed to the board of Crompton Parkinson, Limited. He will retain his appointment as an assistant managing director on the executive board and as general manager of the Guiseley works.

Mr. E. S. LITTLE has been re-appointed a director of the British Thomson-Houston Company, Limited, on relinquishing his offices of comptroller and secretary. He will be succeeded as comptroller by Mr. A. D. GREGORY and as secretary by Mr. A. E. WILSON.

Dr. WILLIAM D. HARGREAVES has been appointed principal of the Richard Thomas & Baldwins Staff Training College. He is expected to take up his appointment during May. For the past two years Dr. Hargreaves has been administrative officer for management courses run by the British Iron and Steel Federation.

The Hon. R. A. BALFOUR, chairman of Arthur Balfour & Company, Limited, tool manufacturers, Sheffield, has been appointed president of the Association of British Chambers of Commerce in succession to Lord Mills, Minister of Power, who resigned. Mr. Balfour, the son of Lord Riverdale, is a past-president of Sheffield Chamber of Commerce.

Metropolitan-Vickers Electrical Company, Limited, announces that Mr. C. H. FLURSCHEIM has been appointed chief electrical engineer of the company. Mr. Flurscheim succeeds Mr. H. WEST who will thus be able to devote more of his time to the affairs of AEI-John Thompson Nuclear Energy Company, Limited, of which he is a director.

One of Britain's leading commercial vehicle export sales executives, Mr. J. M. E. FELL, director-export of A.C.V. Sales, Limited, has left on a world tour of his group's export markets. Before he returns in the summer he will have visited Iraq, Iran, India, Pakistan, Ceylon, Malaya, Australasia, and North America, and he hopes to surpass his previous world sales tour total of orders booked—over £1,000,000.

Mr. THOMAS M. GRANT, a director and secretary of Raine & Company, Limited, iron and steel manufacturers, of Newcastle-upon-Tyne, and Consul for Portugal, has been re-elected Chancellor of the Newcastle Consular Corps for the twelfth year in succession, an office which puts him in charge of the organization which deals with trade and commercial relations between Newcastle and the rest of the world. Mr. Grant has the unusual distinction of receiving knighthoods from two different countries. He is a knight of the Portuguese Order of Christ and a Chevalier of the French Legion of Honour. Two years ago the French President also appointed him an Officer of the French Academy.

Obituary

The death is announced of Mr. BERNARD WRAGG, chairman of Thomas Wragg & Sons (Sheffield), Limited, firebrick manufacturers, Loxley, Sheffield.

Mr. EDWARD TINGLE, Sheffield and district representative of Gaskell & Chambers, Limited, bar fitters, Nursery Street, Sheffield, for 32 years, has died at the age of 55.

The death is announced, at the age of 39, of Mr. ETIENNE DOAT, a senior member of the staff of the *Centre Technique des Industries de la Fonderie*. He had been with the *Centre* ever since his graduation from the French foundry college.

The death took place very suddenly on February 5 of Mr. ERNEST DOUGLAS KEAY, chairman of E. C. & J. Keay, Limited, structural engineers, bridge and girder manufacturers, etc., of Henley-in-Arden (Warwickshire). He was also a director of a number of companies including Iron & General Investments, Limited.

The death is announced of Mr. W. D. VAN HOMRIGH. Once a cashier with the Coalbrookdale Company, Limited, he had served with the Sinclair Iron Company, Limited, and was a director of James Clay (Wellington), Limited, agricultural engineers and ironfounders. Mr. van Homrigh was a Shropshire County Councillor from 1928 until 1946.

The death occurred on January 25 of Mr. WILLIAM HOLLAND, who for many years has been a commercial representative for James Durran & Sons, Limited, of Penistone. He served his apprenticeship at Metropolitan-Vickers, Limited, Trafford Park. He was extremely interested in the technology of foundry practice and was very active in technical institute work and president, with distinction, over the Lancashire branch of the Institute of British Foundrymen. Few foundrymen were better known in the North of England, and his passing will be mourned by a wide circle of friends.

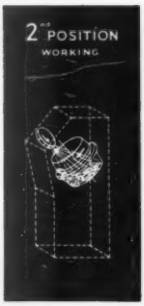
Mr. THOMAS MONTGOMERY SERVICE, a director and former armour manager of William Beardmore & Company, Limited, the Glasgow steelmakers, died on February 5 at the age of 84. He joined the company as a junior chemist and seven years later, in 1896, he transferred to the newly formed armour department as an assistant to the late Mr. George Ritchie. In 1919, with Sir Andrew McCance, he founded the Clyde Alloy Steel Company, Limited. He remained metallurgical adviser to William Beardmore & Company and returned to that company in his former capacity in 1921. He became a director in 1939. Mr. Service, who was a president of the West of Scotland Iron and Steel Institute in 1948-49, was made a CBE in 1948 for his work in helping to meet the defence requirements of the country during two world wars.

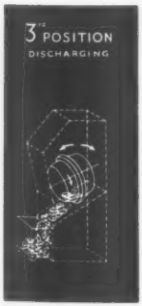
TEN ACRES OF LAND at Kirk Hallam (Derbyshire) have been purchased by the Stanton Ironworks Company, Limited. The property is widely known as Ilkeston's "beauty spot." The company secretary, Mr. W. N. Barke, said that it was too early to say what the future of the property might be.

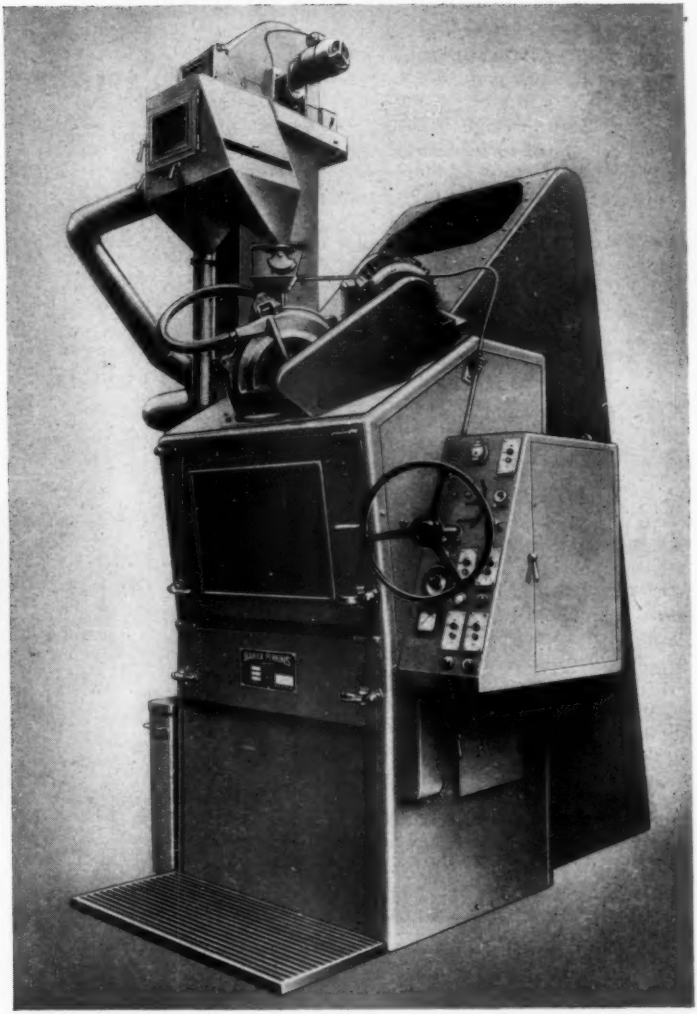
THE GOVERNORS of Paisley Technical College are to go ahead with plans for new buildings which will cost £500,000. The Government has promised a grant of £300,000 if the college can raise the remainder in an appeal to industry and the public. Enrolments in the college have grown from 1,100 in 1946 to 2,800 this year.

BAKER PERKINS Shot Blast Equipment

Rotating Barrel Shot-Blast Machine







BAKER PERKINS LTD
Engineers
WESTWOOD WORKS – PETERBOROUGH

Forthcoming Events

FEBRUARY 18

British Institute of Management

"Impressions of a Visit to Canadian Industry," by Brig. C. Arnold-Edwards, O.B.E., 6.30 p.m., at Management House, 8, Hill Street, London, W.1.

Sheffield Society of Engineers and Metallurgists

"Radiation Damage to Metals," by W. H. Lomer, PH.D., 7.30 p.m., at the Engineering Theatre, University Buildings, St. George's Square. (Joint meeting with the Sheffield local section and the Institute of Metals.)

FEBRUARY 19

Institute of British Foundrymen

Slough section:—"Mechanical Properties of Test-bars and Castings," by Dr. E. Scheuer, F.I.M., 7.30 p.m., at the Lecture Theatre, High Duty Alloys, Limited.

North-East Metallurgical Society

"Metallurgical Principles of Light-alloy Foundry Practice," by W. A. Baker, D.SC., 7.15 p.m., at the Cleveland Scientific and Technical Institution, Middlesbrough.

FEBRUARY 20

Incorporated Plant Engineers

Blackburn branch:—"Application and Maintenance of Centrifugal Pumps," by G. O. Stevenson, 7.30 p.m., at the Golden Lion Hotel.

Institution of Production Engineers

Derby section:—"Powder Metallurgy," by Dr. P. R. Marshall, B.SC., PH.D., 7 p.m., at the Irongates Hotel, Irongate.

Institution of Works Managers

Doncaster branch:—"UK Exports and Foreign Competition," by S. G. Soman, 7.30 p.m., at the Danum Hotel.

Institute of British Foundrymen

Scottish North-East section:—Discussion on problem castings, 7.30 p.m. (Details from the secretary.)

FEBRUARY 21

Institute of British Foundrymen

East Midlands section:—"Green-sand Moulding Technique," and "High-duty Iron Technique," by H. Haynes and C. R. Van der Ben, 7.30 p.m., at the Hind Hotel, Wellingborough.

FEBRUARY 22

Institute of British Foundrymen

West Wales section:—"Steel Castings," by J. G. Bailes, 7 p.m., at Llanelly Technical College.

Falkirk section:—Annual general meeting followed by "Effect of Some Foundry Conditions on 'Boiling' in Bath Enamelling," by W. T. Watt and W. Hamilton, 7.30 p.m., at the Temperance Café, Lint Riggs.

Society of Industrial Radiology

"Penetrants in Non-destructive Testing," by R. Bentley, 7 p.m., at the British Institute of Radiology, 32, Welbeck Street, London, W.1.

Manchester Association of Engineers

"Photography in Engineering," by L. Mullins, M.SC., PH.D., 6.45 p.m., at the Engineers' Club, Albert Square.

FEBRUARY 23

Institute of British Foundrymen

Wales and Monmouth branch:—"Steel Castings," by J. G. Bailes, 6 p.m., at the Engineers' Institute, Cardiff.

Burnley section:—Annual dinner/dance at the Odeon Cinema, Accrington.

East Midlands section:—Films—"Flow of Metals," presented by Mr. J. Hird, and "Sandstorm Secrets," 6 p.m., at the College of Technology and Commerce, Leicester.

SUMMERSON HOLDINGS, LIMITED, announce the formation of a new company, Tracon, Limited, who are to handle the sales connected with the new Tracon collapsible aluminium container. It is also announced that this product will be manufactured in the new Carnmoney factory situated in the Northern Ireland Government Industrial estate at Carnmoney, a northern suburb of Belfast.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

BRIERLEY HILL, February 22—Cast-iron manhole covers and gully gates and frames for the year ending March 31, 1958, for the Urban District Council. Mr. R. H. J. Comber, engineer and surveyor, Civic Buildings, Brierley Hill (Staffs).

BROMLEY CROSS, February 24—Cast-iron gully grates and manhole covers for the year ending March 31, 1958, for the Turton Urban District Council. Mr. Reginald Dart, engineer and surveyor, Council Offices, Bromley Cross, near Bolton.

HASLINGDEN, March 1—Castings for the year ending March 31, 1958, for the Borough Council. The Borough Surveyor, Municipal Offices, Haslingden, Rossendale (Lancs).

HEMEL HEMPSTEAD, February 22—Light and heavy castings; cast-iron pipes and specials; copper tubes and fittings, etc., during the fiscal year 1957-58, for the Borough Council. Mr. C. W. G. T. Kirk, town clerk, Hemel Hempstead (Herts).

LANCASTER, February 22—Manhole covers, gully gratings, and iron castings; iron water pipes and special castings for 12 months from April 1, for the Corporation. The City Engineer, Town Hall, Lancaster.

LEES, February 16—Iron castings for the year ending March 31, 1958, for the Urban District Council. The Surveyor, Council Offices, Lees, near Oldham (Lancs).

MAESTEG, February 23—Iron castings for the year commencing April 1, for the Urban District Council. Mr. Lewis W. Jones, engineer and surveyor, Council Offices, Maesteg (Glam).

POOLE, February 18—Iron castings, manhole covers, etc., during the 12 months ending March 31, 1958, for the Borough Council. The Borough Engineer, Municipal Buildings, Poole (Dorset).

RHODESIA AND NYASALAND, March 26—Electric arc furnace, for the Rhodesia Railways. (ESB/3021/57.)

SALISBURY, February 18—Iron castings during the year commencing April 1, for the City Council. The City Engineer, The Council House, Bourne Hill, Salisbury.

SOUTH AFRICA, February 27—Foundry ladles, for the Stores Department, South African Railways. (ESB/2821/57.)

URUGUAY, February 27—Machines and tools for motor maintenance shops, for the Administración Nacional de Combustibles Alcohol y Portland. (ESB/2556/57.)

WORKINGTON, February 16—Manhole covers and gully grates and frames for the 12 months ending March 31, 1958, for the Borough Council. The Borough Engineer and Surveyor, "Stoneleigh," Park End Road, Workington.

Board Changes

NEGRETTI & ZAMBRA, LIMITED—Mr. J. H. Bailey has joined the board.

RUSTON & HORNSBY, LIMITED—Mr. Charles T. Alderson has been appointed a director.

MANCHESTER DRY DOCKS COMPANY, LIMITED—Mr. C. M. B. Boulter, who has been secretary of the company for the last 13 years, has been appointed a director.

MORGAN CRUCIBLE COMPANY, LIMITED—Mr. J. K. Vaughan-Morgan, on his appointment as Parliamentary Secretary to the Ministry of Health, has resigned from the board.

A. C. COSSOR, LIMITED—Mr. H. T. Shepherd, financial comptroller of the company, has been appointed managing director of Best Products, Limited, domestic electrical apparatus manufacturers, of Felixstowe, a Cossor subsidiary.

DE HAVILLAND (HOLDINGS), LIMITED—Mr. Hugh Buckingham and Mr. P. C. Garratt have been appointed special directors. Mr. Buckingham is a director, general manager, and chief executive of the de Havilland Engine Company, Limited, and Mr. Garratt is chairman and managing director of de Havilland Aircraft of Canada.